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South Dakota Farm and Home Research

South Dakota State University

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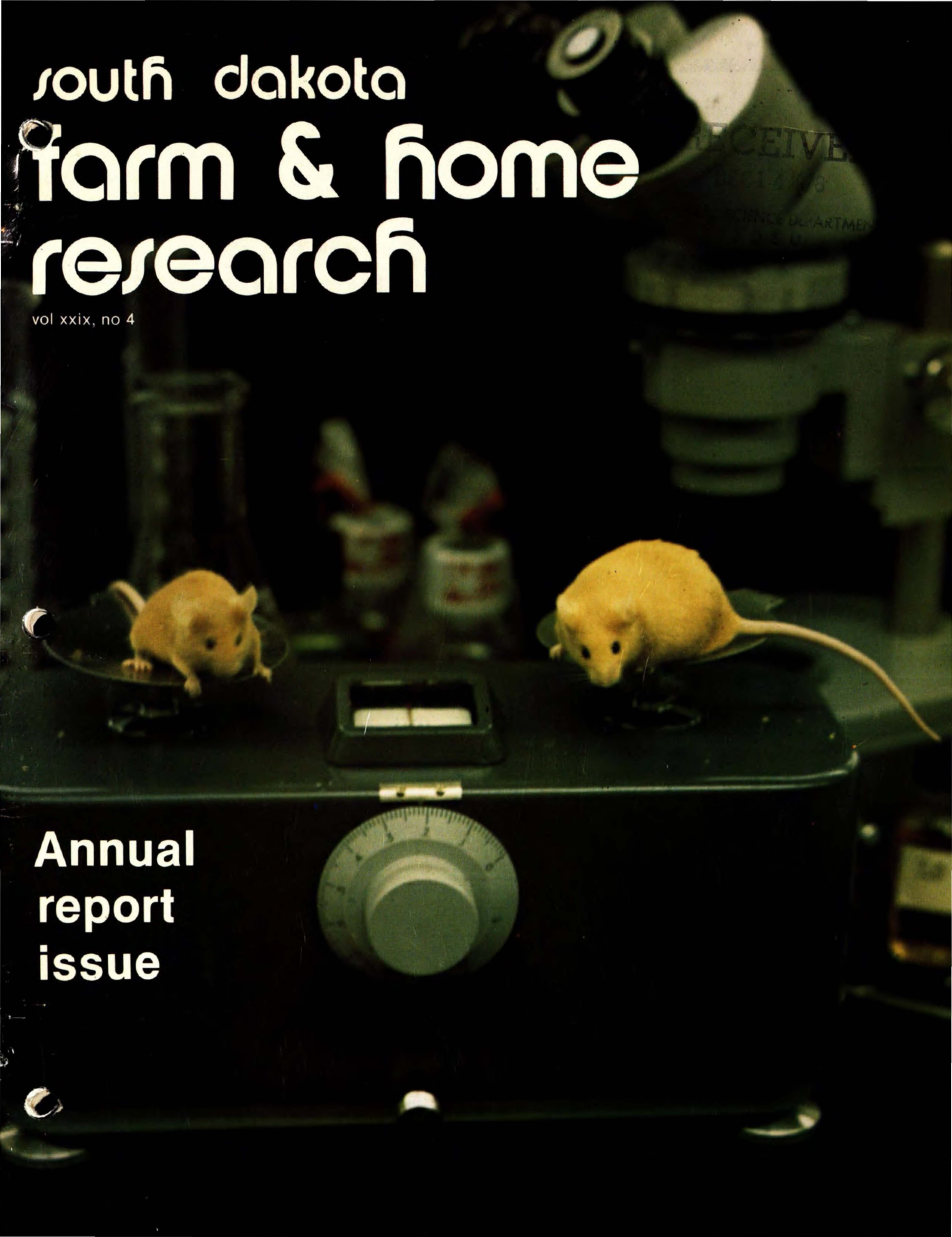
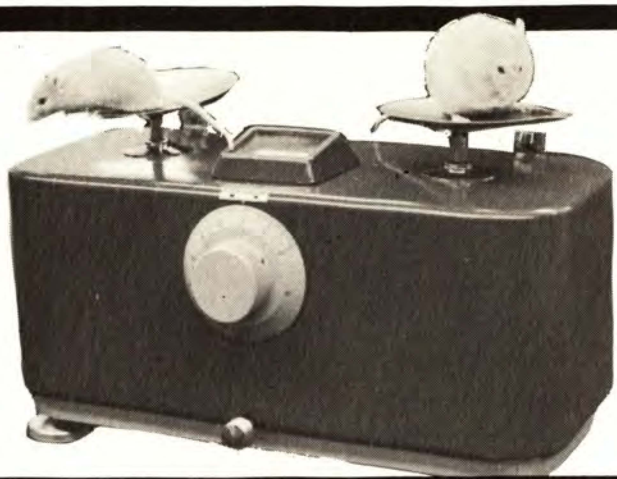


Annual report issue

About our cover



One is fat and one is lean. The slim mouse is the younger, and his genetic makeup has set his pattern of growth. He will inevitably grow as fat as the older mouse. That excess weight will cut his life short, and it predisposes him to cancer. But if he had been born with a black coat, we couldn't have said these things about him. A story on yellow mice and SDSU research into their genetic secrets is on page 13.

South Dakota State University
College of Agriculture and Biological Sciences

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south dakota farm & home research

Serving the people of South Dakota through Teaching, Research, Extension

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Director's comments

Wording changes, emphasis shifts, as we modernize Station goals. But ultimate goal is same since 1887— service to South Dakotans

R.A. Moore
Director, Experiment Station

Perhaps you've decided to purchase a new car next year. Or, maybe you've set out to increase your average corn yield by 20 bushels. Regardless of the goal you set, achieving it requires planning, work, and sacrifice.

The same is true on a larger, broader scale for institutions and organizations, and the South Dakota Agricultural Experiment Station is no exception.

Before you decided to purchase an automobile, you decided that your family had needs that can no longer be met with the present transportation available. That's called a broad goal and perhaps a starting point.

A broad goal for experiment stations was outlined by legislation in 1887 when they first were established. Summarized, this legislation says that stations were founded to assist farmers and ranchers in providing food and fiber for the remainder of the population. Subsequent legislation has broadened that scope in some instances and made it more specific in others.

Before you reached your specific auto purchasing goal, you probably went to the other members of your family to determine needs and suggested alternatives for a vehicle that could be used and enjoyed. Together you decided the best way to spend the money available.

When we set goals for the Experiment Station in South Dakota, we visit with numerous advisory boards, other interest groups, and individuals to do the same thing. We make a list of problems that these people think we should focus on in our research programs. We try to evaluate these in terms of which will provide the greatest benefit to the most people. We relate that list to the help and expertise available on our research staff. We also check with other institutions like ours through regional committees to determine if the work needed has been done elsewhere. Once we define the problem to be researched, the next step is to search out the possible alternatives.

Because our financial resources are always limited—as your personal finances may be, too— the decision on how to get the most benefit from available research funds can be very difficult.

Goals are broad enough to apply for 10 or more years

We believe long range goals should be good for 10 to 15 years, but, of course, some need less time, others longer. For example, take the development of Ralgro, an FDA cleared implant for slaughter cattle. (See the story about implants in this issue.) Our Experiment Station helped with clearance procedures for this implant, with 12 years elapsing between discovery of the product, investigation, and clearance for on-farm use.

Water and energy are two subjects that have become high priority items at the station in recent years. We devoted the spring issue of *Farm & Home Research* this year to water subjects. In this current issue, energy is the focus in two stories—one on the manufacture of glucose and another about solar energy use on the farm.

We use this annual report to call attention to a few of these areas and projects in which we have been working. Other issues of this magazine have emphasized other areas. Most, but not all, of the specific research projects described in this publication and past issues fit under one of these long range goals.

Implementing others will occur when resources shift or additional support becomes possible. For many reasons, these goals or the more specific ones within them are changed from time to time.

For example, unexpected Hessian fly damage to spring wheat this year has caused us to shift priorities to that area. As a result of the request of a number of grain producers, we have added and/or shifted resources toward investigation of that insect and selection of Hessian fly resistant spring wheat varieties.

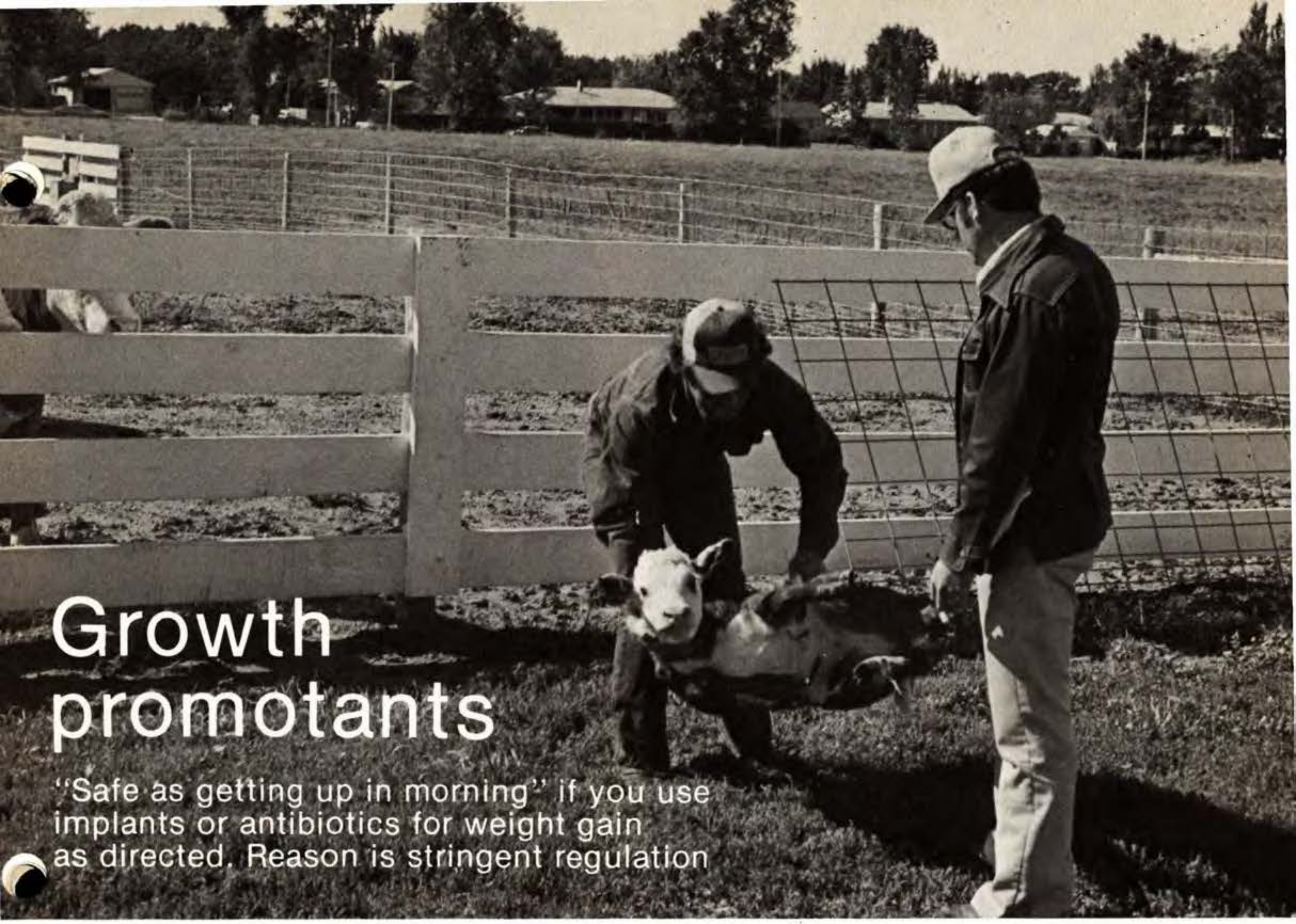
Order of goals does not indicate any priority

Most of the goals we are in the process of establishing are broad categories within which our various scientists and other personnel can narrow down more specific goals according to their special areas of knowledge, research, and resources. The goals listed below are not in any particular order. Number 12 may be just as important to a large segment of our public as number 1.

We list them for your consideration:

1. Evaluate irrigation research to provide more accurate information on best management of crops, soils, and water and to study potential irrigation development effects on environment and society.
2. Provide information on alternative energy sources for agriculture and on the use of agricultural products, residues, and industrial waste as sources of energy.
3. Increase crop production through the development and evaluation of improved crop varieties.
4. Increase efficient red meat and dairy production through improved techniques of breeding, nutrition, disease control, and improve processing of meat and dairy products.
5. Research alternative marketing systems for merchandising South Dakota agricultural products such as meat and cereal crops to maximize producer income.
6. Increase the productivity of pasture and range land.
7. Provide knowledge base for making better farm and ranch management decisions.
8. Provide information on the use and effectiveness of pesticides and commercial fertilizer including alternatives to their use.
9. Expand the data base on human resources.
10. Develop alternatives for better use of outdoor space and other natural resources for recreation and aesthetic purposes.
11. Develop and evaluate engineering for farm buildings and equipment used for South Dakota crop and livestock production.
12. Improve the quality of farm life in South Dakota through research in foods, nutrition, and clothing.

Though these goals map valuable roadways, like your new car goal, they are not rooted in cement. Above any goal lies good reason, reason which can change over time. As past Station history shows—today's goals often lead to tomorrow's discoveries. □



Growth promotants

"Safe as getting up in morning" if you use implants or antibiotics for weight gain as directed. Reason is stringent regulation

Implanting slaughter calves early in the nursing phase and re-implanting periodically throughout growing and finishing—these two management procedures are used by many South Dakota cattlemen. Others may want to consider it, too.

Research at SDSU and universities around the country indicate these two practices will help cattlemen get good quality beef off to market at less cost.

Gerry L. Kuhl, Extension livestock nutritionist at SDSU, says that cow-calf operators who can give a suckling calf an extra few minutes and an implant costing less than $1 per head are likely to get an additional 15-20 pound gain at weaning from that calf.

If this same calf gets another implant in 80 to 100 days, the calf probably will have a 30-40 pound advantage at weaning time over a similar animal that has not been implanted at all. Then, an additional implant can be administered every 80 to 120 days thereafter to maximize the animal's performance during the growing and finishing phases.

Make this procedure routine with cattle destined for slaughter and the result can be big savings from a small investment, according to Kuhl.

A little "homework" is necessary before implanting

However, implanting hormone and hormone-like substances such as DES (diethylstilbestrol), Ralgro (zeranol), and Synovex is no panacea for those in the cattle business. Kuhl emphasizes that implants must be used alongside other excellent feeding, breeding, and management practices for maximum results. Implants are not cleared for use on breeding animals—only those for slaughter.

Administering implants calls for conscientious responsibility by cattlemen to use the approved ones correctly. SDSU recommended growth promotants are summarized in the accompanying chart. DES and Ralgro can be used for suckling calves, yearlings on grass, or feedlot cattle.

Synovex-S for steers and Synovex-H for heifers work well for cattle on pasture or in the feedlot. They're not yet approved by the Food and Drug Administration (FDA), however, for suckling calves. Also not approved for nursing calves but definitely recommended for cattle after weaning are two other products which may be added to the feed rather than implanted. They are MGA (melengestrol acetate) for intact heifers only and Rumensin (monensin sodium) for animals 400 pounds and over.

Kuhl says that cattle producers have the responsibility for following label directions carefully. That includes heeding any warnings and using the product only for the species and intended purpose. It means using only the drug combinations approved, storing the feeds and drugs properly, and strictly observing withdrawal periods.

The chart shows recommended dosages, withdrawal times, and a guide indicating possible improvement in rate of growth of feed efficiency.

After he's caught and thrown (preceding page), calf gets implant at back of ear with Ralgro device (insert). At left is Jesse Lewis, beef production unit manager; at right Gerry Kuhl, Extension livestock nutritionist.

Lawrence Embry has been involved in implant, growth promotant, and/or antibiotic work for 25 years.

SDSU has 25 years' experience in implanting

The chart appears simple. But behind those recommendations are years and years of research by virtually every state university in the U.S. as well as studies and investment by commercial companies.

South Dakota Agricultural Experiment Station has been involved in examining various aspects of growth promotants for approximately 25 years. A man leading much of that research during those years is Lawrence B. Embry, animal scientist specializing in nutrition.

Embry says the Experiment Station has been using DES, Synovex, and Ralgro since the very early stages of growth promotants. SDSU was involved in research for federal clearance procedures for MGA, Ralgro, Rumensin, and some antibiotics.

He explains that several of the recommended growth promotants are hormone or hormone-like substances which generally stimulate metabolism beneficially, or improve the deposition of nutrients an animal eats.

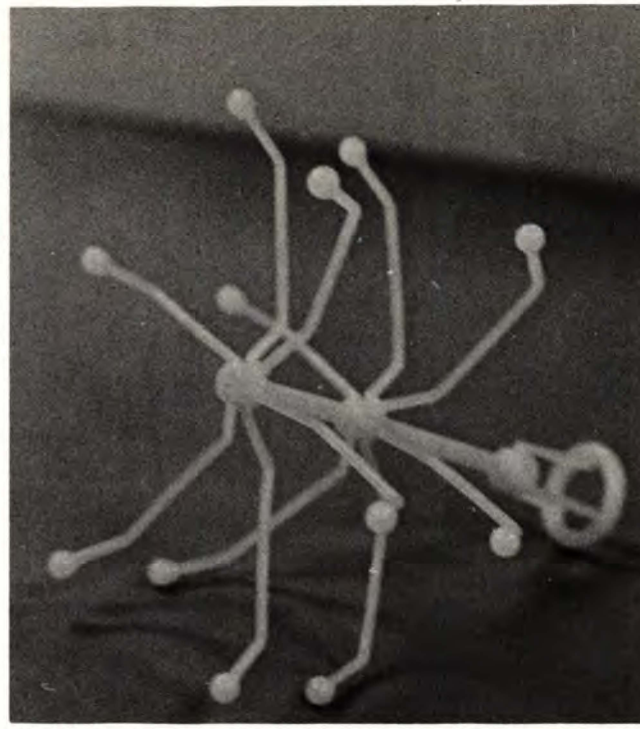
In addition to improving an animal's well-being, many other regulations are required in clearing a growth promotant product for use.

Tissue residues and toxicity levels are checked under varying circumstances for safety of the animals and for meat consumption. And the feed additive or implant must be effective for the use claimed.

FDA cleared compounds to aid rate of growth and/or feed efficiency for cattle fed for slaughter.

Compound	Level approved for use	Improvement in Rate of growth	Improvement in Feed efficiency	Withdrawal Time before Slaughter
	(Per head)	%	%	
IMPLANTS				
Diethylstilbestrol (DES)				120 days
Suckling calves	12 mg	3-12		
Yearlings on grass	12 or 24 mg	10-20		
Feedlot	36 mg	10-15	10	
Ralgro (zeranol)				65 days
Suckling calves	36 mg	4-8		
Yearlings on grass	36 mg	10-20		
Feedlot	36 mg	8-12	8-10	
Synovex-S for steers				60 days
(Estradiol benzoate	20 mg			
and progesterone)	200 mg			
Yearlings on grass		15-20		
Feedlot		8-12	8-10	
Synovex-H for heifers				60 days
(Estradiol benzoate,	20 mg			
testosterone pro-pionate)	200 mg			
Yearlings on grass		15-20		
Feedlot		8-12	8-10	
FEED ADDITIVES	(Per head/day)			
Diethylstilbestrol (DES)	10 or 20 mg	10-15	10	14 days
Melengestrol Acetate (MGA) for intact heifers only	.25-.50 mg	10-12	5	48 hours
Rumensin (monensin sodium)	30 g/ton		10	None

Left to right are devices for administering DES, Synovex, and Ralgro.



SDSU research has shown that the Hei-Gro device, inserted in the vagina of heifers, did not show any added growth.

Embry believes that research and regulations backing the use of growth promotants and their release are stringent. For example, when Ralgro received FDA clearance in 1970, 12 years passed from discovery through investigation to approval.

Some growth promotants can't pass rigid tests

The number of growth promotants that finally reach clearance is extremely small compared with the number that have been tested, according to the scientist.

An example of one that didn't make the SDSU recommended list has been tested by the Experiment Station recently. It, called the Hei-Gro device, is a satellite-looking piece of white nylon about the size of a man's fist. Inserted in the vagina of a heifer, it was purported to perform the function of a growth promotant.

Already on sale since it is not a drug, this device sells for about $2 each. However, it just didn't work in the tests by Embry, Jim Goodman, and Lowell Slyter, SDSU animal scientists.

They divided 96 Hereford heifers randomly into four groups—those with Synovex-H, Hei-Gro, Synovex-H plus Hei-Gro, and the control group. Any differences in gain among the groups that could be attributed to the Hei-Gro device were not significant. And some 30% of the heifers lost the device during the experiment. Studies at other U.S. and Canadian universities also have failed to show a consistent beneficial response.

Embry figures that tests such as these save cattlemen thousands of dollars. He says the Hei-Gro device already had been used in several states, but he estimates that not many South Dakota cattlemen have bought it.

Station's work gives farmers some options

South Dakota's Experiment Station has had its share of contributions to the development of the growth promotants that do work.

"One of the Station's early contributions was showing that we get a response in rate of gain and feed efficiency from implanting in a wide variety of feeder cattle conditions," Embry says. "We noted its continuous response to suckling and growing rations, pasture feeding, and drylot finishing. Also, we were one of the early ones to demonstrate that bulls show no response to DES, Synovex, or Ralgro.

"We also showed in early research that spaying heifers reduced their rate of gain but that spayed heifers implanted with DES or Synovex-H gained at about the same rates as intact heifers similarly implanted. This also provides the advantage of running heifers intended for later feedlot finishing and bulls in the same pasture and offers reasonable proof to prospective buyers that the heifers are, indeed, open."

In addition, SDSU feedlot tests have shown that, for the implants on the chart, one does not consistently have an advantage over another. No advantage has been demonstrated, either, for changing from one implant to another with the same animal such as is sometimes recommended with antibiotics.

Antibiotics are another type of compound often lumped in the growth promotant category but are different from the hormone and hormone-like substances mentioned so far. These antibiotics are those which are fed orally and routinely to control very low, or subclinical, levels of disease which most animals have much of the time. The results from feeding recommended levels of antibiotics are improvements in rate of growth and a small improvement in feed efficiency. Also, certain compounds may reduce cases of liver abscesses, foot rot, and digestive problems.

At SDSU, tests have been conducted with several antibiotics for these purposes. Chlortetracycline and oxytetracycline are among the most popular ones used today. But bacitracin and tylosin are also effective and on the recommended list.

The scientists point out that feeding one of these antibiotics or Rumensin in combination with an implant has been shown to be additive under several circumstances. The response from the two will be greater than from either alone. An additive response depends on the nature and functions of the products and conditions of use.

Producers cannot simply use any of the implants, antibiotics, and feed additives together. For appropriate combinations, they should check with someone like Kuhl, Embry, a nutrition specialist, Extension personnel or a veterinarian.

Used responsibly, growth promotants are safe for animals and humans

Both Embry and Kuhl agree that implanting beef probably has been one of the most researched beef subjects in the last 25 years. That alone should be reassuring to those who have concerns about the safety of using implants and feed additives and of eating meat from treated animals.

The safety of feeding or implanting tested growth promotants according to recommendations might be compared to the safety of getting up in the morning, according to Embry.

Very significant in a society of escalating costs, growth promotants offer the cattle industry the chance to produce meat at a price reasonable for a consumer to pay.

According to Embry and Kuhl, the tons of hamburgers and juicy steaks on American tables today are among the most carefully scrutinized meats for human consumption in history. □

Ranch with a difference

Mother Nature doesn't always know best. Norbeck station shows tame grasses and alfalfa can belong in grazing program

At first glance, the place looks like any other ranch.

White faced cattle graze over acres and acres of green grass.

The land is flat with only a gentle slope to it. Typical prairie ground, mostly grass with some cropland. "Good South Dakota cow country," is how Dale Curtis describes it.

The buildings are fairly typical: a house, granary, machine shed, feedlot, cattle shed.

It's not unusual to find the hands dressed in cowboy hats, jeans, and high-heeled boots.

That is the resident staff. But on certain days you see some fellows around in dress slacks, low-cut shoes, and blue caps, driving state cars. These are professors, who have reason to be here.

This spread, located near Faulkton at Norbeck, is leased by SDSU. The sign out front reads Pasture Research Center.

On this ranch can be found some of the native grasses that grew here when the covered wagons went through. The native grasses are grazed in competition with some tame introduced grasses. The researchers also planted rows of alfalfa in native range (called interseeding) to improve carrying capacity.

Purpose of center is more beef per acre at highest profit

Here SDSU researchers have been experimenting the last 14 years to learn ways that ranchers can better manage their pastures and rangeland to get more beef production per acre at a better profit.

The years of research are paying off with information that is being passed along to the farmer and the rancher, according to Dale Curtis, the resident superintendent of the research center.

"We're getting a pretty fair handle on some different grazing systems, comparing the tame series with the native," said Curtis.

"Interseeding is one of the big things we've done of benefit to ranchers, because we've proven it can be done in this part of the state. We need to work on it so we can get better stands (of alfalfa) in drier parts of the state. We are doing some work with crop barriers such as sunflowers and Sudangrass, hoping they will hold some snow over the winter so we can go in and get the alfalfa established the next year.

"Farmers can come here and see how interseeding of alfalfa increases the carrying capacity, not only by yielding more forage, but also by putting nitrogen in the soil and increasing the yield of native grasses already in the pasture," said Curtis.

The staff of the research center also tries to show farmers and ranchers the advantage of grazing different kinds of grasses at different times of the year. "When it's hot and dry, you want to be on a warm-season grass like a switchgrass or Sudangrass which is then fairly lush. We try to show them that you go on that kind of grass when it is lush and at its peak period," said Curtis.

Work will probably close out in 1980

Early work at the center was primarily with cows and calves. Since 1975 the emphasis shifted to raising steers.

The latest results of research are made public about every 2 or 3 years at a field day when farmers and ranchers from a wide area are invited to spend a whole day touring the farm and hearing talks by the professors.

Most South Dakota ranchsteads don't have "grass gardens," but Superintendent Dale Curtis keeps one up for visitors.

At the last field day, June 14,1978, Dr. Ray Moore, director of the SDSU Agricultural Experiment Station, remarked that the center "has provided much needed information for farmers and ranchers."

He also announced that the center will probably close when the current lease expires in 1980. He said it is university policy to move some of its stations to better serve the entire state.

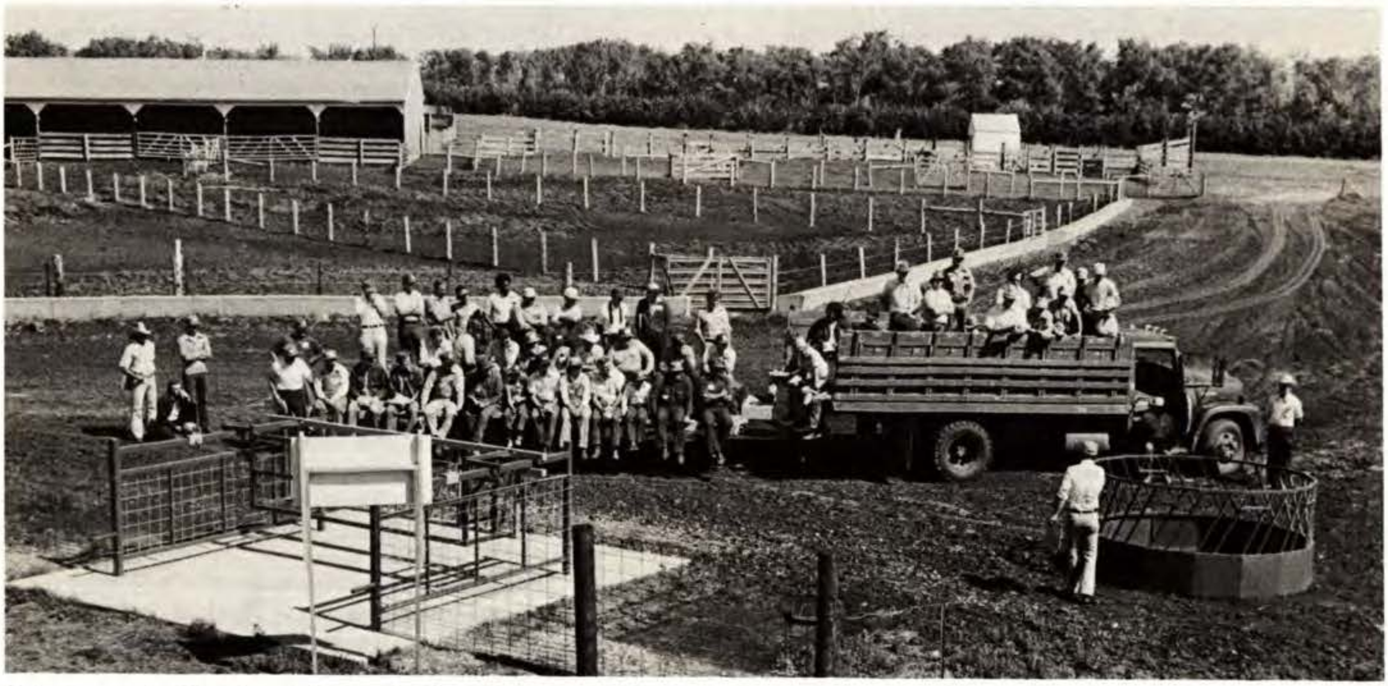
The Pasture Research Center was established in 1965 to study ways of improving pasture and forage production. The site on the John and Curtis Wik property was typical of about a 20-county area in central South Dakota. The farm, consisting of 2,665 acres, is located 3 miles west of Wecota and a mile north.

A $90,000 federal grant in 1965 provided the means for establishing the center. That grant was to study "the efficiency of beef cattle production in South Dakota with various methods of land use and cattle management."

Three hundred uniform heifers were purchased from one herd and became the basis for a cow-calf operation used to evaluate native pastures, short season tame pastures and a full-season tame pasture series.

Researchers looked at the effect on the reproductive performance of the cows as indicated by the number of calves, weights of calves, and total beef produced per acre.

They did many other experiments over the years. They studied ways of planting grasses and alfalfa, with or without nurse crops. They studied rates of seeding and different mixtures of seed. They looked at fertilization, weed con-



This summer's field day at the station featured talks on the research going on there and guided tours. One tour has stopped to hear about a hay feeder designed to cut down on wastage.

Leon Wrage grows weeds. The Extension specialist is checking the effect of herbicides on wormwood sage.

trol, supplemental pastures, and seed production. They also studied grazing management and the long-span suspension fencing program.

In 1975, an additional federal grant of \$146,000 provided an opportunity to change directions in the major research effort and continue the center for another 5 years, said Moore.

This time the emphasis shifted to finding the most efficient way of minimizing the use of forages in growing and finishing beef cattle. The scientists take yearling cattle and study them with native and improved pastures at different levels of energy supplements and different winter rations.

The Pasture Research Center has been an "excellent cooperative project" among departments at the university, including plant science, ag engineering, animal science, economics, horticulture, and microbiology.

Moore himself was at one time project leader of the center. He points out that some of the pastures established in 1965 are still productive. They demonstrate that "pastures can remain productive indefinitely when properly established and managed," he said.

Other project leaders at the station include Rudy Vigil, present leader, and Charles Krueger and Jim Green, former leaders.

Curtis is the third superintendent. The others were Gary Haiwick and Jim Olson.

At the 1978 field day, several professors reported on their research.

Native range is not the best pasture system

Richard Shane, assistant professor of economics, says that beef producers can get better net returns by using pasture systems other than strictly native range.

Short-season pasture systems yield the highest returns, but interseeded pasture systems yield the highest returns with lesser productivity levels.

More intensive pasture management holds the potential for raising cattle producers' net incomes by increasing carrying capacity on currently used acreages and reducing the need to expand by buying more land, he says.

Increased carrying capacity of cattle operations does not insure a higher return to labor and management, because profit of pasture systems is influenced by many variables.

He analyzed several systems at Norbeck, including 1) native range; 2) short-season tame grass consisting of a mixture of Teton alfalfa, smooth bromegrass, and Oahe intermediate wheatgrass; 3)long-season tame pasture consisting of a mixture of Teton alfalfa, smooth bromegrass, and Oahe intermediate wheatgrass plus separate pastures of crested wheatgrass for early spring grazing and Russian wildrye for fall grazing; and 4) native pasture interseeded in 30-inch rows with Travois, a pasture type alfalfa.

Vigil, the current project leader and assistant professor of plant science, reported this summer that improving pasture systems increases their carrying capacity.

The improved carrying capacity doesn't increase gains per animals or average daily gains, however.

Vigil spoke on a paper prepared by himself, Krueger, and Curtis. The study looked at three basic pasture systems—native range, native-interseeded range and full-season tame series.

The tame series pastures had a "significantly higher" carrying capacity than either the interseeded or native range at all grain supplement levels, Vigil said.

Even though the carrying capacity was high with the tame series pasture system, the yearly input for maintaining the system was also higher, making the interseeded range a more economical system for beef production in central South Dakota, reported economist Shane.

Interseeding significantly increased carrying capacity of the native range from approximately 34 to 46 grazing days per acre, or a 35% increase in grazing days with no corn supplement.

The tame series system had 55 grazing days per acre, an increase of 62% over the native and 19% over the interseeded range, assuming no corn supplement. Carrying capacity was also increased by increasing grain levels.

Fertilizer can trigger undesirable chain of events

If farmers fertilize a warm-season grass, they should do it right or they may trigger a reaction that defeats their purpose of boosting pasture production.

Fertilize a warm-season grass with nitrogen the first part of June and use only the amount of fertilizer that the crop will need during that season, researchers say.

Nitrogen fertilizer applied to native grass and switchgrass plots at Norbeck set off this chain of events: Too-early applications of nitrogen stimulated cool-season grasses and some weeds which tended to choke out the warm-season grasses. If more nitrogen was applied than used by the grass, the residual nitrogen was then available early the next spring for the cool-season "invaders."

Early June is the time to plant warm-season grass species used in establishing pastures for summer livestock grazing.

One important use of two categories of grasses—the cool-season and the warm-season—is fitting them into the season-long programs of pasture management that provide a longer grazing period.

As the names suggest, one of the grasses thrives in the cool weather of early spring and autumn while the other requires higher temperatures for establishment and growth.

Paul L. Carson, professor of plant science, says that tacking an extra week or two on each end of the pasturing season by growing cool-season grasses is one way an expanding South Dakota livestock industry can get more badly needed pasture.

"We have at least 10 cool-season grasses suitable for varying conditions; there are at least three ways of obtaining the all-important nitrogen needed for high yields; and the know-how of good management is readily available," the scientist points out.

Some cool-season grasses grown in South Dakota include crested wheat, western wheat, tall wheat, reed canary, creeping meadow fescue, Russian wildrye, bluegrass, bromegrass, intermediate wheatgrass, and green needlegrass.

"One of the most important factors for top-notch cool-season grass production is sufficient available nitrogen, because in general every ton of grass produced contains 30 pounds of this element," Carson says.

Three of several ways to supply supplemental nitrogen are to plant a pasture-type legume with the grass as the cheapest source of nitrogen; add manure although it is usually best for row crops; or apply commerical fertilizer although the cost has increased over the years.

Lawrence B. Embry, professor of animal science, says that feeding a cow herd on pasture is mainly a matter of economics and convenience in comparison to using harvested forages and grains when taking into consideration all costs, such as labor, facilities, equipment, land, livestock, and likely returns.

The most pronounced effects on cow and calf production over a long-term study using several pasture systems have been carrying capacity of pastures and total days of grazing, Embry said.

Research information on animal requirements and forage composition indicate that these would be the main differences among a wide variety of pasture types when managed to utilize the forages at their top stages of nutritive value.

Besides hosting from hundreds to thousands of visitors on field days, the Pasture Research Center gives individual tours to groups on special occasions. Curtis invites spectators to come to the farm because "we are here for the public and are more than happy to show them around. That's an important part of what we do." □

Agricultural Experiment Station South Dakota State University Brookings, S.D.

91st annual report

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Mrs. James (Celia) Miner, Yankton
Bonnie Bunch, Hayes
Susan Nelson, Madison

Executive

S. O. Berg, PhD, President
D. D. Dearborn, PhD, Dean
R. A. Moore, PhD, Associate Dean & Director
W. A. Bugg, BSA, Director of Finance
R. P. Stohr, Executive Assistant

Station Statistician

W. L. Tucker, PhD, Professor

Electron Microscopist

N. H. Granholm, PhD, Associate Professor

BioEngineering

A. E. Dracy, PhD, Professor

Ag Engineering

D. L. Moe, D Sci, Professor and Head
S. T. Chu, PhD, Associate Professor
T. Chisholm, PhD, Associate Professor
L. W. Cluever, MS, Instructor
D. W. DeBoer, PhD, Associate Professor
R. Devine, MS, Assistant Professor, R(6-78)
A. C. Dittman, BS, Research Associate
M. A. Hellickson, PhD, Associate Professor
G. W. Buller, MS, Assistant In
G. Durland, MS, Associate Professor
M. L. Kimmons, PhD, Associate Professor
L. Lubinus, BS, Associate Professor
T. M. Klosterman, BS, Research Farm Superintendent
W. F. Lytle, MS, Associate Professor
D. D. Pahl, BS, Assistant Professor
W. Peterson, MS, Associate Professor
C. H. Ullery, PhD, Assistant Professor
L. R. Verma, PhD, Assistant Professor
H. G. Young, MS, Associate Professor

Ag Information

J. L. Pates, MS, Agricultural Editor
M. R. Brashier, MS, Information Specialist-Publications
L. M. Jorgensen, MS, Information Specialist-Ag News and Features
F. J. Shideler, MS, Information Specialist-Ag Publications

Animal Science

H. J. Tuma, PhD, Professor and Head, R(8-26-77)
L. C Blome, BS, Superintendent, Cottonwood Range Field Station
M. A. Brown, PhD, Assistant Professor
L. F. Bush, PhD, Associate Professor
R. I. Butterfield, MS, Assistant In
C. W. Carlson, PhD, Professor
W. J. Costello, PhD, Associate Professor
G. H. Deutscher, PhD, Assistant Professor
C. A. Dinkel, PhD, Professor

L. B. Embry, PhD, Professor
F. R. Gartner, PhD, Associate Professor
D. H. Gee, PhD, Associate Professor
D. N. Haber, BS, Assistant In, R(1-5-78)
W. Heintz, BS, Assistant In, R(3-31-78)
D. Kamstra, PhD, Professor
P. H. Kohler, PhD, Professor
G. L. Kuhl, PhD, Assistant Professor
J. E. Lewis, BS, Assistant In
J. K. Lewis, MS, Associate Professor
G. W. Libal, PhD, Assistant Professor
T. Lingscheit, BS, Assistant In
R. M. Luther, PhD, Professor
J. W. McCarty, MS, Associate Professor
W. C. McCone, MS, Associate Professor
R. A. Nelson, MS, Assistant In
J. Peschl, BS, Assistant In
P. E. Plumart, MS, Associate Professor
A. L. Slyter, PhD, Associate Professor
W. R. Trevillyan, BS, Superintendent, Antelope
R. C. Wahlstrom, PhD, Professor
T. Weber, BS, Assistant In, A(5-1-78)
S. S. Waller, PhD, Assistant Professor

Botany-Biology

G. A. Myers, PhD, Professor and Head
J. P. Chamie, PhD, Assistant Professor
C. H. Chen, PhD, Professor
M. K. Diggins, PhD, Associate Professor
C. Gregory, MS, Instructor
L. Haertel, MS, Professor
D. J. Holden, PhD, Professor
H. L. Hutcheson, PhD, Associate Professor
R. McMullen, PhD, Assistant Professor
C. Morgan, PhD, Professor
Morrill, MA, Associate Professor
S. Nelson, PhD, Assistant Professor
E. S. Olson, MS, Associate Professor
G. Peterson, DA, Associate Professor
J. Rasmussen, PhD, Associate Professor
R. H. Whalen, PhD, Associate Professor
C. A. Taylor, MS, Professor

Dairy Science

J. Parsons, PhD, Associate Professor and Head, A(5-15-78)
R. J. Baker, PhD, Professor
F. C. Ludens, BS, Assistant In
R. McGuffey, PhD, Assistant Professor
S. W. Seas, MS, Associate Professor
D. J. Schingoethe, PhD, Associate Professor
E. W. Skyberg, BS, Assistant In
K. R. Spurgeon, PhD, Professor
H. H. Voelker, PhD, Professor

Economics

J. E. Thompson, PhD, Professor and Head
W. G. Aanderud, PhD, Professor
H. R. Allen, PhD, Professor
J. Antonides, MS, Associate Professor
. Benning, MS, Associate Professor
L. Berry, PhD, Associate Professor
T. E. Daves, PhD, Professor
R. O. Felberg, MS, Associate Professor
C. A. Fischer, BS, Assistant In
H. A. Gilbert, PhD, Professor
H. Greenbaum, PhD, Associate Professor
F. H. Hsia, PhD, Professor
W. E. Kamps, PhD, Associate Professor
G. L. Kelsey, MS, Associate Professor
H. J. Kim, PhD, Associate Professor
W. Kohlmeyer, MS, Professor Emeritus
C. E. Lamberton, PhD, Associate Professor
A. A. Lundeen, PhD, Assistant Professor
P. A. Lyons, MBA & JD, Associate Professor
G. E. Murra, PhD, Professor
M. S. Myers, PhD, Professor
R. E. Olson, MS, Associate Professor
D. L. Peterson, PhD, Assistant Professor
R. C. Shane, PhD, Assistant Professor
A. B. Sogn, MS, Associate Professor
E. D. Ullrich, MS-USDA-C, Assistant Professor
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Entomology-Zoology

R. J. Walstrom, PhD, Professor and Head
N. Ahmad, PhD, Research Associate
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M. A. Conner, BS, Assistant In
E. R. Easton, PhD, Assistant Professor
J. R. Fisher, PhD USDA-C, Assistant Professor, A(10-1-77)
A. Greichus, PhD, Professor
R. D. Gustin, PhD USDA-C, Assistant Professor
J. D. Haertel, PhD, Associate Professor
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E. J. Hugghins, PhD, Professor
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V. M. Kirk, PhD USDA-C, Professor
J. L. Krysan, PhD USDA-C, Associate Professor
B. McDaniel, PhD, Professor
M. H. Roller, PhD, Professor
G. R. Sutter, PhD, USDA-C, Associate Professor
R. N. Swanson, PhD, Professor
G. A. Thibodeau, PhD, Associate Professor
D. D. Walgenbach, PhD, Associate Professor

Home Economics

A. Gilbert, PhD, Professor and Dean
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L. P. Guild, MS, Associate Professor
M. Hurlocker, MS, Associate Professor
W. A. Johnson, PhD, Associate Professor
C. R. Sivers, MS, Associate Professor

Horticulture-Forestry

R. M. Peterson, PhD, Professor and Head
N. W. Baer, PhD, Research Associate
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C. A. Curran, Assistant In, R(5-31-78)
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L. C. Johnson, MS, Associate Professor
J. E. Klett, MS, Associate Professor
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P. E. Nordstrom, PhD, Associate Professor
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Microbiology

T. R. Wilkinson, PhD, Professor and Head
R. J. Baker, PhD, Professor
J. K. Fuller, BS, Instructor, R(6-30-78)
R. P. Hillam, PhD, Assistant Professor
P. R. Middaugh, PhD, Professor
R. M. Pengra, PhD, Professor
R. S. Shave, MS, Assistant Professor
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Plant Science

C. R. Krueger, PhD, Professor and Head, R(8-18-78)
E. P. Adams, MS, Associate Professor, Deceased 6-22-78
D. J. Anderson, BS, Assistant In,
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C. D. Dybing, PhD, USDA-C, Professor
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D. L. Keim, PhD, Assistant Professor
D. G. Kenefick, PhD, Professor
Q. S. Kingsley, MS, Assistant Professor R(5-4-78)
R. A. Kohl, PhD, Associate Professor
C. L. Lay, PhD, Assistant Professor
A. O. Lunden, PhD, Associate Professor
D. D. Malo, PhD, Assistant Professor
C. J. Mankin, PhD, Professor
D. D. MaCauley, BS, Assistant In
T. J. Martin, BS, Assistant In
C. S. Nelson, BS, Assistant In, R(9-16-77)
J. D. Otta, PhD, Associate Professor

L. H. Penny, PhD USDA-C, Professor, R(10-77)
P. B. Price, PhD USDA-C, Professor
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R. R. Vigil, PhD, Assistant Professor
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D. G. Wells, PhD, Professor
F. C. Westin, PhD, Professor
E. M. White, PhD, Professor
E. Williamson, MS, Associate Professor
C. W. Wirth, BS, Assistant In
L. S. Wood, PhD, Professor
L. J. Wrage, MS, Associate Professor
M. A. Wrucke, BS, Assistant In

Rural Sociology

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G. W. Grant, MA, Instructor, A(8-16-77)
L. A. Hannus, MA, Instructor
D. J. Hess, PhD, Assistant Professor
W. C. Mackey, PhD, Instructor, A(8-16-77)
R. Mendelsohn, PhD, Assistant Professor
M. P. Riley, PhD, Professor
R. T. Wagner, PhD, Associate Professor

Station Biochemistry

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R. J. Emerick, PhD, Professor
Y. A. Greichus, PhD, Professor
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A. W. Halverson, PhD, Professor
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O. E. Olson, PhD, Professor
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D. Pravecek, BS, Assistant In, R(8-15-77)
N. Thiex, MS, Instructor
E. I. Whitehead, MS, Professor

Veterinary Science

M. W. Vorhies, DVM, MS, Professor and Head
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M. E. Bergeland, DVM, PhD, Professor
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Wildlife & Fisheries Sciences

C. G. Scalet, PhD, Associate Professor and Head
R. L. Applegate, PhD, USDI-C, Associate Professor
L. D. Flake, PhD, Associate Professor
R. L. Linder, PhD, USDI-C, Professor
J. T. Ratti, PhD, Assistant Professor A(10-1-77)
F. Schitoskey, PhD, USDI-C, Associate Professor
R. C. Simon, PhD, USDI-C, Professor

Projects

Administration

Mechanism of gene action in the t^{12}/t^{12} embryonic mouse lethal, Granholm.
Phenology, weather, and crop yields (Remote Sensing), Myers.
A telemetry system for the continuous in vivo monitoring of rumenal pH, Dracy.
South Dakota agricultural manpower study, Hanson.

Agricultural Engineering

Climatic resources of the North Central region, Lytle.
Trickle and sprinkler irrigation of shallow rooted vegetable and berry crops, DeBoer.
Thermal comfort design criteria for agricultural machine operator enclosures, Turnquist.
Relationship of daily and climatological weather variables to ag production, Lytle.
Livestock confinement and environmental control systems relationships with climate and environment, Hellickson.
Energy utilization and efficiency in ag production, Hellickson.
Equipment for reduced tillage systems, Johnson.
Oahe irrigation distribution network alternatives, Chu.
Wind energy for agricultural applications, Verma.
Irrigation system performance and pumping plant capacity evaluation, DeBoer.
Forage production and utilization systems as a base for beef and dairy cattle, Chisholm.

Animal Science

Improvement of beef cattle through breeding methods, Dinkel.
Mercury in our environment, Carlson, Emerick.
Cellulosic wastes as potential ruminant feeds, Kamstra.
Range lamb production, Slyter.
Operation research methods with particular reference to livestock enterprises, Dinkel.
Controlling insects affecting livestock, Kohler.
Physical and chemical properties of ruminant diets, Embry.
Nitrogen supplementation for ruminants, Embry.
Mating and management systems for commercial beef production, Deutscher.
Range improvement techniques, Gartner.
Mineral nutrition and metabolism in livestock, Embry, Emerick.
Effect of range condition on beef production, water balance, and energy balance of grassland ecosystems, Lewis.
Composition, nutritive value, and stability of poultry meat and egg products, Carlson.
Preparation, preservation, and storage of livestock feeds, Luther.
Systems of marketing cereal grains and forages through growing and finishing cattle, Schneider.
Causes of fatty liver hemorrhagic syndrome (FLHS), Carlson.
Nutrient requirements and management interrelationships of sows, Wahlstrom.
Lamb production, Slyter.
Reproductive efficiency of livestock, Slyter.
Fabricated meat characteristics, Costello.
Dietary stimulants in poultry production, Guenthner.
Amino acid requirements of laying hens, Carlson.
Protein-amino acid-mineral levels and interrelationships affecting performance and body composition of swine, Wahlstrom.
Swine management and housing systems and the interrelationships of management, environment, physiology, and nutrition, Wahlstrom.
Wintering cows fed according to environmental variations, McCone.
Feeding and management systems for feedlot heifers, Embry.
Forage production and utilization systems as a base for beef and dairy cattle, Kamstra, Chisholm.

Botany-Biology

Tissue culture techniques for use in breeding monocot species, Chen.
Epidemiology and control of wheat streak mosaic virus, McMullen.
Tissue culture of endangered plant species

and their establishment on protected areas, Holden.
Effect of sediment control dams on water quality of a prairie lake, Haertel.

Fiel

Dairy Science

Analysis of dairy products, Baker.
High protein oats in dairy cattle rations, Voelker.
Improving quality, yields, and economic contributions of dairy products, Spurgeon.
Effects of composition and processing on nutrient quality and consumer acceptance of dairy foods, Parsons.
Whey utilization by dairy cattle, Schingoethe.
Improving dairy cattle through breeding with special emphasis on selection, Voelker.
Nutrition of high producing dairy cows, Schingoethe.
Improving large dairy herd management practices, McGuffey.
Optimizing the nutritional utilization of forages by dairy cattle, McGuffey.

Economics

Economic and public finance impacts and alternative land use developments. Morse.
Income variability and diversification of crop and livestock enterprises, Peterson.
Organization and control of the U. S. food production and distribution system, Olson.
Economics of machinery ownership and use on Northern Great Plains farms, Daves.
Application of microcomputer technology to accounting in farm and ranch management, Dracy, Allen.
Agricultural credit policies of commercial banks during a period of extreme drought conditions, Greenbaum.
Alternative rural freight, transportation, storage, and distribution systems, Lamberton.
Budgeting procedures for community services, Morse.
Grain producers' marketing strategies for meeting rapidly changing conditions, Sogn.
The value of water for domestic use, Lundeen.
Farm ownership, tenancy, and size problems of family farms, Berry.
The economic value of water used for agricultural purposes in eastern South Dakota, Shane.
Tax impacts on farmers and ranchers, Kamps.

Entomology-Zoology

Survey entomologist, Walgenbach.
Lungworm and other parasites in wild ruminants, Hugghins.
Ecology and control of the western and northern corn rootworm, Walgenbach.
Biology, ecology, behavior, and control of blood sucking Diptera, Balsbaugh.
Effect of above-ground invertebrates on net primary production in a grassland ecosystem, McDaniel.
Nutritional and metabolic interrelationships enhancing absorption and placental transfer of iron and other nutrients, Swanson.
Alfalfa insects, Walstrom.
Effects of ammonia intoxication on mammalian body tissue function, Roller.
Pesticide impact assessment, Walgenbach.
Identification, quantification, and physiological requirements of metals in hog roundworm, Greichus.

Home Economics

Phosphate as a regulator of carbohydrate-lipid metabolism, Guild.
Low temperature home laundry effectiveness and energy consumption, Sivers.
Nutritional impact of fat altered diets, Johnson.
Cost, absorbency, and durability of disposable and non-disposable diapers, Hurlocker.
Utilization and nutritional value of bison meat, Deethardt.
Analysis of soil retained after low temperature laundry of toweling and sheeting, Hurlocker.

Horticulture-Forestry

Parks and outdoor recreation site resource potential, and park and recreation patterns, Nordstrom.
Improved tomato varieties or hybrids for home and commercial production, Prashar.
Improved fruit cultivars and cultural practices, Peterson.
Selection, propagation, and culture of annuals, herbaceous perennials, and woody ornamentals for the northern Plains, Klett.
Trees suitable for environmental tree plantings, Baer.
New plants for industrial and agricultural utilization, Peterson.
Increasing vegetable production, Prashar.
Establishment and growth of trees and shrubs for environmental tree plantings, Collins.
Effect of nitrogen source and water quality on growth and cold hardiness of ornamental plants, Klett.

Microbiology

Purine synthesis, regulation, and mutants of soil bacteria and nitrogen fixation, Westby.
Listeria in the environment with respect to overt listeric infection in livestock, Wilkinson.
Role of nitrogen fixing organisms in soil fertility, Pengra.
Animal waste management systems for the 1980's, Middaugh.
Immunochemical analysis of the lipopolysaccharide of Rhizobium isolated from native legumes, Hillam.
Market quality of convenience foods, Middaugh.

Plant Science

Breeding of superior field corn hybrids, Shank.
Foundation seed stocks, Weber.
Seed certification, Colburn.
Seed testing, Gelderman.
Crop performance testing, Bonnemann.
Crop and soil management with and without supplemental water, Fine.
Determination of soil properties: ecological selection of range and pasture plant species, White.
Breeding and testing barley for South Dakota and upper Midwest conditions, Price.
Environmental accumulation of nutrients as affected by soil and crop management, White.
Root infecting fungi, Buchenau.
Breeding and testing superior grasses, Ross.
Ribonuclease as a determinant or as an associative factor in winter hardiness of barley, Kenefick.
A soil testing and soil fertility program to increase the productivity of South Dakota soils, Carson.
Range improvement and crop production in western South Dakota by several agronomic methods, Johnson.
Nematodes associated with field crops, grasses, and legumes, Smolik.
Local soil geography and soil fertility relationships, Malo.
Plant pathogenic bacteria on seeds and plant propagative materials, Otta.
Forage production and utilization systems for growing and finishing beef cattle, Green.
Winter wheat improvement, Wells.
Cultural practices for improving crop production, Shubeck.
Identification and control of shelterbelt and ornamental tree diseases, Otta.
Plant growth control, Arnold.
Physiological factors which may limit yield in flax and soybeans, Dybing.
Relating soil and landscape characteristics to land use, Westin.
Sunflower management for production and insect control, Kingsley.
Educational and diagnostic services for identifying plant diseases for crop producers and general public, Mankin.
Breeding cool-season forage species for improved feeding value and productivity, Ross.
Relationship of corn and four annual grasses to the epidemiology of wheat streak mosaic virus, Gardner.

Flax breeding and cultural practices, Lay.
Oats and rye adapted to South Dakota, Reeves.
Spring wheat breeding, Keim.
Characterizing the available soil water holding capacity, Kohl.
Forage management systems for cow-calf production in the Northern Great Plains, Vigil.
Seed production of breeding lines of insect pollinated legumes, Ross.
Forage production and utilization systems as a base for beef and dairy cattle production, Vigil, Chisholm.
Cellular photosynthetic process and the regulation of photosynthesis, Kenefick.
Reduction of corn losses due to nematodes, Smolik.
Evapotranspiration and irrigation scheduling, Evenson.

Rural Sociology

Population redistribution in the North Central region, Riley.
Career interests and aspirations of native American youth residing in reservation areas, Hess.
Impact of multi-county planning district activities as perceived by planning district residents, Dimit.
Population change in South Dakota, Wagner.

Station Biochemistry

Analytical services, Olson.
Biochemistry of selenium, Palmer.
Mercury in our environment, Emerick.
Role of zinc in tryptophan synthesis and growth regulation in corn, Whitehead.
Mineral nutrition and metabolism in livestock, Emerick.
Ribonuclease as a determinant or as an associative factor in winter hardiness of barley, Whitehead, Kenefick.
Polychlorinated biphenyls in animals, Greichus.
Manganese oxide deposition in waterlines, Gehrke.

Veterinary Science

Agalactia syndrome of sows, Ellis.
Bovine neonatal colibacillosis, Ellis.
Diagnosis of bovine abortion, Kirkbride.
Reo-like virus enteric infection in swine, McAdaragh.
Prevention and control of enteric diseases of swine, Ellis.
Swine pseudorabies virus infection, McAdaragh.

Wildlife and Fisheries Sciences

Wetland and waterfowl production, Flake.
Ring-necked pheasants in east-central South Dakota, with special reference to habitat and predation, Flake.
Fish production in farm and ranch waters, Scalet.
Shelterbelts as avian habitat, Vohs.
Food habits, taxonomic status, and prey inactions of the coyote, Schitoskey.
Hungarian partridge studies in eastern South Dakota, Ratti.

Publications and Contributions to Journals

Agricultural Engineering

Articles, reports, papers:

Buller, G.W., and M.A. Hellickson. 1977. Model studies of manure pit ventilation systems. ASAE Paper NCR 77-1017.

____ and ____. 1978. Model study of swine manure pit ventilation systems. ASAE Paper 78-4046.

Chisholm, T.S., and R.J. Devine. 1977. Reduced tillage and controlled infield traffic. ASAE Paper NCR 77-1011.

Chu, S.T. 1977. Water table response to a sequence of recharges. Water Resources Research 13(4):738-42.

____. 1977. Open ditch vs buried pipe. South Dakota Farm & Home Research 28(3):21-22.

____. 1977. Transient drainage equations for non-homogeneous soils. Trans ASAE 20(6):1085-88.

____. 1977. Modeling infiltration during a variable rain. ASAE Paper 77-2063.

____. 1977. Adequate application rate for center pivot irrigation. ASAE Paper NCR 77-1003.

____. 1978. Modifield F factor for irrigation laterals. Trans ASAE 21(1):116-8.

____. 1978. Infiltration during an unsteady rain. Water Resources Research 14(3): 461-6.

DeBoer, D.W., D.D. Brosz, and J.L. Wiersma. 1977. Water application depths for optimum crop production. Trans ASAE 20(6): 1067-9 +.

____ and J.D. Melstad. 1977. Drip and sprinkler irrigation of carrots and onions. ASAE Paper 77-2013.

____. 1978. Comparison of three field methods for determining saturated hydraulic conductivity. Accepted for publication in Trans ASAE.

____. 1978. Irrigation permits. South Dakota Farm & Home Research 29(2):9-10.

____ and D. Pahl. 1978. Energy alternatives. South Dakota Farm & Home Research 29(2):19-21.

____, A. Dittman, P. Prashar, and M. Brashier. 1978. Drip vegetables. South Dakota Farm & Home Research 29(2):6-7.

____ and S.T. Chu. 1978. Application and economics of bi-level drainage. Int Commission on Irrigation and Drainage, 10th Congress, R 27, 34.1-34.1.380.

Egan, R.K., and M.A. Hellickson. 1978. Ridge vent and wind direction effects on ventilation characteristics of a model open front livestock building. Trans ASAE 21(1):146-51.

Hellickson, M.A., W.H. Peterson, S.E. Saienga, and J.L. Julson. 1977. Agricultural crop drying and space heating using a solar energy intensifier. 4th Annual UME-ONC Conference on Energy, Rolla, Missouri.

____ et al. 1977. Performance of a solar energy-intensifier with thermal energy storage. ASAE Paper 77-4533.

____ and F.J. Shideler. 1977. Energy: Do-it-yourself heating. South Dakota Farm and Home Research 28(3):19-21.

____. 1978. Crop drying and agricultural space heating using a solar-intensifier. Final report, Cooperative Agreement 12-14-3001-9, USDA-ARS.

____. 1978. Model studies of geometry and wind direction effects on ventilation characteristics of naturally ventilated buildings. Final report, Butler Mfg. Co., Inc.

Julson, J.L. 1977. Supplemental space heating using a solar energy intensifier-thermal energy storage system. MS thesis, SDSU.

____, M.A. Hellickson and W.H. Peterson. 1977. Solar heating with a solar energy-intensifier-thermal energy storage system. ASAE Paper NCR 77-1006.

Johnson, C.E., E.A. Dowding, and P.K. Turquist. 1977. A power driven hay core sampler. Trans ASAE 20(4):638-639.

____ et al. 1977. A weighing system for field use. Trans ASAE 20(4).

____ and W.B. Voorhees. 1978. A three point hitch force dynamometer. Accepted for publication in Trans ASAE.

____, L.L. Jensen, R.L. Schafer, and A.C. Bailey. 1978. Some soil tool analogs. Accepted for publication in Trans ASAE.

Otterby, M.A., and D.W. DeBoer. 1977. Economic analysis of multiple pivot irgation on a droughty soil. ASAE Paper 77-2006.

Peterson, W.H., and M.A. Hellickson. 1977. Solar drying of shelled corn in South Dakota. ASAE Paper NCR77-1008.

Saienga, S.E., M.A. Hellickson, and W.H. Peterson. 1977. Crop drying with a solar energy-intensifier. ASAE Paper NCR77-1005.

____. 1977. Design and testing of a solar energy-intensifier for drying shelled corn. MS thesis, SDSU.

Verma, L.R., K. VonBargen, F.G. Owen, and L.J. Perry, Jr. 1978. Characteristics of mechanically formed hay packages after storage. Int Grain and Forage Harvesting Conference Proceedings, published by ASAE, p. 286.

Publications:

Chisholm, T.S., L.D. Kamstra, F.R. Vigil, and G.R. Durland. 1978. Large hay packages: Harvesting through feeding. SDCES FS 689.

Peterson, W.H., and M.A. Hellickson. 1977. Solar drying progress report. SDCES EMC 657.

Field day reports:

Chisholm, T.S., R. J. Devine, T.M. Klosterman, and D.C. Curtis. 1978. Larger rack for limit feeding any hay packages. Pasture Research Center Report, p 43.

____, L.D. Kamstra, and R.J. Devine. 1978. Limit feeding hay to dry pregnant cows. Pasture Research Center Report, p 40.

Animal Science

Articles, reports, papers:

Carlson, C.W., D.J. Bray, and G.J. Mountney. 1977. Scientist-year and publication expenditures for U.S. poultry research in 1974 and 1975. Poultry Sci 56(6):1960-1967.

Deutscher, G.H. 1978. Factors influencing dystocia and pelvic area in beef heifers. Abstr Amer Soc Anim Sci, Midwest Section.

____. 1978. Research summary report for NCR-87, beef cow calf management committee. Compiled and edited, 34 pp.

Dinkel, C.A., and M.A. Brown. 1978. An evaluation of the ratio of calf weight to cow weight as an indicator of cow efficiency. J Anim Sci 46(3):614.

Gates, R.N., and L.B. Embry. 1977. Monensin and protein supplementation with corn silage rations for growing cattle. Amer Soc Anim Sci Abstr 585, p. 234.

____, ____, and L.F. Bush. 1977. Monensin, tylosin and protein supplementation with finishing cattle. Amer Soc Anim Sci Abstr 586, p. 235.

Girard, J.L., G.W. Libal, and R.C. Wahlstrom. 1977. Lysine-energy relationships in swine diets. Amer Soc Anim Sci Abstr 230, p. 90

Goodman, J.P., A.L. Slyter, and L.B. Embry. 1978. The effect of the Hei-Gro intravaginal device and Synovex-H implants on feedlot performance and cyclic activity of growing beef heifers. Abstr Amer Soc Anim Sci, Midwest Section.

Huntington, G.B., R.J. Emerick, and L.B. Embry. 1977. Sodium bentonite effects when fed at various levels with high-concentrate diets to lambs. J Anim Sci 45:119-125.

____ et al. 1977. Sodium bentonite or sodium carbonate as aids in feeding high-concentrate diets to lambs. J Anim Sci 45:804-811.

Kashani, A.B., and C.W. Carlson. 1977. Responses of two strains to amino acids in a 10% protein diet. Poultry Sci 56:1728. (abstr).

Kuzmicky, D.D., A.L. Livingston, R.E. Knowles, G.O. Kohler, E. Guenthner, O.E. Olson, and C.W. Carlson. 1977. Xanthophyll availability of alfalfa leaf protein concentrate (Pro-Xan) for broilers and laying hens. Poultry Sci 56(5):1504-1509.

Libal, G.W., and R.C. Wahlstrom. 1977. Effect of gestation metabolizable energy levels on sow productivity. J Anim Sci 45:286-292.

____, ____, S.L. Robbins, and J.L. Girard. 1977. Bone development of pigs as affected by calcium and phosphorus levels and floor types. Amer Soc Anim Sci Abstr No. 253, p. 99.

Nelson, R.A., and C.W. Carlson. 1977. Low protein diets and their effects on reproductive performance. Poultry Sci 56:1742. (abstr).

____ and ____. 1977. Effects of fat level in force fed diets on production and liver parameters. Fed Proc 36:1143 (abstr).

NCR-42 Committee on Swine Nutrition. 1978. Effect of protein level during gestation and lactation on reproductive performance in swine. J Anim Sci 46:1673.

Plumart, P.E. 1977. Classroom planning of farm enterprises with the computer. Poultry Sci 56(5):1748 (abstr).

Song, H., and C.A. Dinkel. 1977. A mathematical model of feed intake for growing beef cattle. Abstr Amer Soc Anim Sci, Northeast Section.

Wahlstrom, R. C., and G.W. Libal. 1977. Effect of dietary protein during growth and gestation on development and reproductive performance of gilts. J Anim Sci 45:94-99.

____ and ____. 1977. The effect of varying levels of high protein oats (Spear) in diets of young weaned pigs. Amer Soc Anim Sci Abstr 287, p. 113.

____, R. V. Merrill, L.J. Reiner, and G.W. Libal. 1977. Mutant corns in young pig diets and amino acid supplementation of opaque-2 corn. J Anim Sci 45:747-753.

____, L.J. Reiner, and G.W. Libal. 1977. Oats, dehulled oats and hulless barley as ingredients in pig starter diets. J Anim Sci 45:948.

Waller, S.S., J.K. Lewis, M.A. Brown, and T.W. Heintz. 1978. Factors involved in estimating green biomass by canopy spectroreflectance measurements. Abstr 78th Annual Meeting, Soc for Range Mgmt.

Publications

Anderson, V., and C.A. Dinkel. 1977. Forage finishing trials. SDAES SESD Exp Farm 17th Annual Prog Rpt: 80-83.

Benning, L., P.E. Plumart, and B.J. Bonzer. 1977. Egg production costs and returns. SDCES FS 671.

Chisholm, T.S., L.D. Kamstra, F.R. Vigil, and G.R. Durland. 1978. Large hay packages: harvesting through feeding. SDCES FS 689.

Deutscher, G.H. 1977. Research on calving difficulty and pelvic measurements. Proc SoMoNo Tri-State Beef School.

____, W.L. Berndt, and G.J. MacLean. 1978. South Dakota cattle grub control research with new crufomate formulation. Down to Earth 34(2).

____, J. Johnson, R. Emerick and R. Moul. 1977. Investigation of beef cattle copper deficiency in northwestern South Dakota. Proc SoMoNo Tri-State Beef School.

Dinkel, C.A. 1977. Principles and application of crossbreeding systems. Proc The Range Beef Cow Symposium V, Chadron, Nebr.

Dunn, B.H. 1977. Sodium bentonite, sodium bicarbonate and limestone supplementation in high-concentrate diets for ruminants. MS thesis, SDSU.

Gartner, F.R. 1977. Rangelands: An American heritage. Film discussion guide published by Society for Range Management with funding support from Old West Regional Commission. 6 pp.

____. 1977 Introduction and co-author of foreword. *In* R. Baumberger, ed, South Dakota Rangeland Resources. Soc for Range Mgmt Old West Regional Range Program. 150 pp.

____. 1977. Introduction and co-author of foreword. *In* D. Bose, ed, Nebraska Rangeland Resources. Soc for Range Mgmt Old West Regional Range Program. 121 pp.

____. 1977.Introduction and co-author of foreword. *In* J.C. Shaver, ed, North Dakota Rangeland Resources. Soc. for Range Mgmt Old West Regional Range Program. 118 pp.

____, L.R. Roath, and E.M. White. 1977. Advantages and disadvantages of prescribed burning. Proc Symposium on Use of Prescribed Burning in Western Woodlands and Range Ecosystems, Utah State Univ., Logan, 14 pp.

Gates, R.N. 1978. Monensin, protein supplementation and tylosin for feedlot cattle. MS thesis, SDSU.

Healy, R., and L.D. Kamstra. 1977. Feed sawdust to cut ration costs. Farm Journal Beef Extra Issue, June-July. 8 pp.

Isakson, J., L.D. Kamstra, and J. Seymour. 1978. Aspen feeding. The Farmer (Dakota Edition), March 18, p. 39.

Kamstra, L.D. 1978. Nontraditional sources of fiber and protein for ruminant rations. Proc 27th Annual Soil and Moisture Clinic. p 6.

____. 1978 Aspen wood material as a feed ingredient in ruminant rations. Proc Alabama Nutr. conf, pp 73-76.

____. 1978. Aspen: food for thought (and cattle). The Drummer, The Ruffed Grouse Society 3(4):3.

Kashani, A.B. 1978. Effects of strain on response of laying hens to low protein diets and amino acid supplements. PhD thesis, SDSU.

Luther, R. M., L.B. Embry, and J.F. Giles. 1977. Feeding nonconventional corn. South Dakota Farm & Home Res. 28(3):9.

Rommereim, D.N. 1977. Flumethasone induction of parturition in the ewe. MS thesis, SDSU.

Schripsema, J.R. 1977. Ecological changes on pine grassland burned in spring, late spring and winter. MS thesis, SDSU, and annual report to National Park Service.

Singh, M. 1978. Utilization of whole aspen tree material as a ruminant feed component. PhD thesis, SDSU.

Field day reports

Benning, L., P.E. Plumart, and B.J. Bonzer. 1977. Egg production costs and returns. SDAES AS Series 77-25.

Carlson, C.W., and E. Guenthner. 1977. Bacitracin supplements for egg production. SDAES AS Series 77-21.

____, ____, and R.A. Nelson. 1977. Probiotics for broilers and turkeys (II). SDAES AS Series 77-20.

Chisholm, T.S., L.D. Kamstra, and R.J. Devine. 1978. Limit feeding of hay to dry pregnant cows. Pasture Research Center Report: 43-49.

Deutscher, G.H. 1978. Beef production and economics of Simmental-Angus and Hereford-Angus crossbred cows. Prog rpt, Cottonwood Research Station. 10 pp.

Dunn, B.H., and L.B. Embry. 1977. Zeranol and diethylstilbestrol implants for feedlot lambs. SDAES AS Series 77-7.

____, R.J. Emerick, and L.B. Embry. 1977. Sodium bicarbonate and sodium bentonite as buffering agents in high-concentrate diets. SDAES AS Series 77-8.

Embry, L.B., and L.F. Bush. 1977. Oat hay or oat haylage for growing cattle. SDAES AS Series 77-12.

Emerick, R.J., J.C. Chern, I.S. Palmer, R.A. Nelson, and C.W. Carlson. 1977. Interrelationships of mercury, selenium and arsenic in broiler diets. SDAES AS Series 77-22.

____, B.H. Dunn, and L.B. Embry. 1977. Limestone as a buffering agent in high-concentrate diets. SDAES AS Series 77-9.

Gates, R. N., and L.B. Embry. 1977. Monensin, tylosin and protein supplementation with finishing cattle. SDAES AS Series 77-11.

Kamstra, L.D., M. Singh, and J. Sharps. 1977. Utilization of aspen trees as a ruminant component. SDAES AS Series 77-15.

Kang, C.W., R.A. Nelson, C.W. Carlson, and O.E. Olson. 1977. Effect of dietary protein level and restricted feeding on egg production, shell quality and certain biochemical parameters in the laying hen. SDAES AS Series 77-26.

Libal, G.W., and R.C. Wahlstrom. 1977. Dehydrated alfalfa in sow and gilt gestation diets. SDAES AS Series 77-36.

____, ____, S. L. Robbins, and J.L. Girard. 1977. Bone development of pigs as affected by calcium and phosphorus levels and floor types. SDAES AS Series 77-37.

Luther, R.M., L.B. Embry, and L.F. Bush. 1977. Vitamin A biopotency as measured by stores of vitamin A in livers of feedlot cattle. SDAES AS Series 77-18.

____, ____, and J. F. Giles. 1978. Conventionally-dried, solar-dried and acid-treated corn and methods of vitamin A supplementation for fattening beef cattle. Prog rpt, James Valley Agr. Res. and Ext. Center, Redfield.

____, ____, D.F. Samuel, and L.F. Bush. 1977. Methods of supplementing carotene and vitamin A to vitamin A-depleted sheep. SDAES AS Series 77-10.

Plumart, P.E. 1977. A six-year summary of egg production costs and income of layer flocks on the SDSU flock record program. SDAES AS Series 77-18.

Wahlstrom, R. C., and G.W. Libal. 1977. High protein (Spear) oats for sows during reproduction. SDAES AS Series 77-29.

____ and ____. 1977. High protein oats in ground and pelleted pig starter diets. SDAES AS Series 77-30.

____ and ____. 1977. Opaque-2 corn in finishing swine diets. SDAES AS Series 77-32.

____ and ____. 1977. Effect of organic iron in starter and grower diets. SDAES AS Series 77-33.

____ and ____. 1977. Effect of housing type, feeder space and pen space on performance of growing-finishing pigs. SDAES AS Series 77-34.

____ and ____. 1977. Compensatory growth in swine. SDAES AS Series 77-35.

____, ____, and J.L. Girard. 1977. Lysine-energy relationships in diets for growing and finishing swine. SDAES AS Series 77-31.

Botany-Biology

Articles, reports, papers:

Chen, C. H., N.E. Stenberg, and J.G. Ross. 1977. Clonal propagation of big bluestem (*Andropogon gerardii* Vitman) by tissue culture. Crop Sci 17:847-50.

Haertel, L. 1977. Effects of zooplankton grazing on nuisance algal blooms. Completion report A-047-SDAK. Office of Water Resources Research and Technology.

____. 1977. Comparative eutrophication and production measurements in prairie lakes. SD Acad Sci 56:105-124.

____. Impact of zooplankton grazing on prairie lake algal standing crops and water transparency. Submitted to Ecology.

Holden, D.J. 1977. Indians in a land called Promise. National Gardener 48:17.

____, B.J. Ellis, and C.H. Chen. 1978. Cloning native prairie plants by tissue culture. Proc 5th Midwest Prairie Conf.

McMullen, C.R., W.S. Gardner, and G.A. Myers. 1977. Ultrastructure of cell wall thickenings and paramural bodies induced by barley stripe mosaic virus. Phytopath 67(4):462-467.

____. 1977. Ultrastructure of corn leaf tissue infected with the ND18 strain of barley stripe mosaic virus. Proc. SD Acad of Sci 56:100-104.

Stenberg, N.E., C.H. Chen, and J.G. Ross. 1978. Regeneration of plantlets from leaf cultures of *Lilium longiflorum* Thumb. Proc SD Acad Sci 56: 152-158.

Wasson, J., and D.J. Holden. 1977. The use of plant tissue culture techniques for studying the morel mushroom. Proc SD Acad of Sci 56:197.

Dairy Science

Articles:

Ahrar, M., and D.J. Schingoethe. 1978. Feeding value of regular and heat-treated soybean meal and sunflower meal for dairy calves. J. Dairy Sci 61 (suppl I):168 (abstr).

Johnson, M.E., J.H. Martin, R.J. Baker, and J.G. Parsons. 1977. Persistence of antibiotics in milk from cows treated late in the dry period. J Dairy Sc 60:1655.

____ et al. 1977. Comparison of several assay procedures to detect penicillin residues in milk. J Food Prot 40:785.

Martin, J.H., M.E. Johnson, R.J. Baker, and J.G. Parsons. 1978. Check on antibiotics: Avoid treating dry cows for mastitis just before calving. South Dakota Farm & Home Res 29(1):18.

McGuffey, R.K., and M. Owens. 1978. Preservation of alfalfa silage in bunker silos. 70th Annual Meeting, Amer Soc Anim Sci.

Muller, L.K., L.V. Schaffer, L.C. Ham, and M.J. Owens. 1977. Cafeteria style free-choice mineral feeder for lactating dairy cows. J Dairy Sci 60:1574.

Owens, M.J., and L.D. Muller. 1977. Alfalfa silage and haylage preservation. Proc 7th Annual Alfalfa Symposium.

____ and ____. 1978. Cafeteria choice. Farm & Home Res 29(1).

Satterness, D.E., J.G. Parsons, J.H. Martin, and K.R. Spurgeon. 1978. Yields of cottage cheese made with cultures and direct acidification. Cult Dairy Prod J 13(1):8.

Schingoethe, D.J. 1977. Use of by-products in feeding dairy cattle. Proc 1977 ND Feed Mfgers Seminar, 4.

____. 1977. Use of whey in livestock diets. Proc 38th MN Nutr Conf, 75.

____. 1977. Feeding replacement heifers. Midwest Dairyman 1(3):8.

____, R.W. Bailey, and E.W. Skyberg. 1977. Digestibility by steers of rations containing large amounts of lactose or dried whey. Proc 69th Ann Meeting, Amer Soc Anim Sci:256 (abstr).

Schroeder, T.L., H.H. Voelker, and D.J. Schingoethe. 1978. Evaluation of high protein oat forage for dairy cattle. J Dairy Sci 61 (suppl 1):142 (abstr).

Sommerfeldt, J.L., D.J. Schingoethe, and L.D. Muller. 1978. Feeding value of brown-midrib corn silage for lactating dairy cows. J Dairy Sci 61 (suppl 1):143 (abstr).

Skyberg, E.W., and D.J. Schingoethe. 1978. Long-term lactational response of dairy cows to dried whey product in the concentrate mixture. J Dairy Sci 61 (suppl 1):187 (abstr).

Ullery, J., and D.J. Schingoethe. 1978. Low cost protein: If you can get cheap sunflower meal, feed it. South Dakota Farm & Home Res 29(1):17.

Voelker, H.H. 1977. Use of high proven sires to increase milk production. SD Holstein News 45:43.

____. 1977. Three-grain silage. South Dakota Farm & Home Res 28:12.

____. 1978. Prices of Holstein sires according to predicted differences for milk and type. J Dairy Sci 61 (suppl 1).

____, P.E. Stake, M.J. Owens, and D.J. Schingoethe. 1977. Oatlage versus oats, barley, wheat combination silages for dairy cattle. J Dairy Sci 60:1083.

____. 1978. High protein boot versus dough stage barley-wheat-oatlage. Proc S[illegible] Acad Sci 56:243.

____, D. J. Schingoethe, and L.D. Muller. 1977. Adding whey improves haylage. Crops & Soils 29(9):21.

Wingfield, J.M, K.R. Spurgeon, and J.H. Martin. 1978. Effects of added whey on yield and acceptability of cheddar cheese. J Dairy Sci 61(suppl 1):120.

Publications, department reports:

McGuffey, R.K. 1978. Storing and feeding alfalfa and small grain forages. DSU 78-9.

Owens, M.J. 1978. What should you expect when you join the dairy testing program (DHI). DSU 78-2.

Parsons, J.G. 1978. Milk protein testing. DSU 78.

Schingoethe, D.J., and M.J. Owens. 1978. Total mixed rations for dairy cattle. DSU 78-6.

Voelker, H.H. 1978. Selecting dairy sires for PD milk compared to selecting for type. DSU 78-1.

Yee, J., and K.R. Spurgeon. 1978. Seasonal and regional differences in the composition of cows' milk in South Dakota. SDAES TB 46.

Economics

Articles:

Gartner, F.R., and A.J. Bateman. 1977. Potential for recreation enterprises on private rangelands in the Great Plains. Soc for Range Mgmt (in press).

Publications:

Allen, H., and D. Jibben. 1977. Budgets for major livestock enterprises in South Dakota. SDAES Circ 220.

Bateman, A. 1978. Hospitality tips for employees serving the traveling public, SDCES EC.

____. 1978. Estimates of gross sales and employment in South Dakota hospitality-recreation-tourism industry, 1976. SDCES.

____. 1977. Local public finance impacts of rural residential development: A case study in the Rapid City school district of South Dakota. SDAES Bul 650.

Bernitz, T., and T. Daves. 1978. Industrial development financing in South Dakota. SDAES Bull.

Berry, R. 1977. Achieving more freedom by farm tenancy improvement. SDAES Circ 218.

Daves, T. 1978. Gasahol: Economic feasibility in South Dakota. SDAES Bul.

Kamps. W, et al. 1978. Community services research in the Great Plains. Great Plains Ag Council Publ 83, vol 2.

____ et al. 1978. Consumer perceptions of selected community services in the Great Plains. Great Plains Ag Council Publ 83, vol 1.

Lamberton, C. 1978. South Dakota railroad branchlines. SDAES Circ.

____. 1977. Historical perspective of South Dakota grain transportation and the outlook for the future. SDAES Bul.

____, and R. Rudel. 1978. The South Dakota grain marketing system. SDAES Bul.

Lundeen, A. 1977. Costs of alternative water systems. LRC report.

Morse, G. 1977. Does industrial development lower taxes? SDCES FS.

____, and A. Lundeen. 1977. Economic simulation of costs and savings from belonging to rural water systems. LRC report.

Olson, R. Two computer programs for AGNET, a regional computer network for agriculture. SDSU.

Field day reports:

Shane, R. 1976. Economic analysis of alternative pasture systems. Pasture Research Center Rpt.

Entomology-Zoology

Ahmad, N., and M. Black. 1977. The hepatic microsomal mixed function oxidase system in man: co-factor effects and the influence of cholestasis. J Pharmacol Expt Ther 203:397-408.

____, G.R. Sutter, and D.D. Walgenbach. 1978. Some properties of microsomal mixed function oxidase in southern and western corn rootworm larvae. Proc NC Br Entomol Soc Amer (abstr).

____, D.D. Walgenbach, and G.R. Sutter. 1978. Persistence of terbufos, fonofos and phorate in South Dakota soil. Proc NC Br Entomol Soc Amer (abstr).

Call, D.J., D.D. Walgenbach, and G.R. Sutter 1977. Corn rootworm cholinesterase activity as influenced by species, sex, age and cold storage. J Econ Entomol 70:533-35.

Deutscher, G.H., W.L. Berndt, and G.J. MacLean. 1977. South Dakota cattle grub control research with a new crufomate formulation. Down to Earth 34:16-17.

Easton, E.R. 1978. Biting flies of cattle from several areas in South Dakota using Manitoba and sticky drum traps. Proc NC Br Entomol Soc Amer 33rd annual meeting (abstr).

____, J.E. Keirans, R.A. Gresbrink, and C.M. Clifford. 1977. Distribution in Oregon of *Ixodes pacificus* Cooley & Kohls, *Dermacentor andersoni* Stiles and *Dermacentor occidentalis* Marx with a note on Dermacentor variabilis (Say) (Acarina:Isodidae). Med Entomol 13(4-5):501-06

Greichus, Y., A. Greichus, B. Ammann, D.J. Call, C.D. Kassien Hamman, and R.M. Pott. 1977. Insecticides, polychlorinated biphenyls and metals in African lake ecosystems. I. Hartbeespoort Dam, Transvaal and Voelvlei Dam, Cape Province, Republic of South Africa. Archives of Environmental Contamination and Toxicology 6:371-383.

____, ____, H.A. Draayer, and B. Marshall. 1978. Insecticides, polychlorinated biphenyls and metals in African lake ecosystems, II. Lake McIlwaine, Rhodesia. Bull of Environmental Contamination & Toxicology 19(4):444-453.

____, ____, B.D. Ammann, and J. Hopcraft. 1978. Insecticides, polychlorinated biphenyls and metals in African lake ecosystems. III. Lake Nakuru, Kenya. Bull of Environmental Contamination & Toxicology 19(4):454-461.

Hedrick, T.W., and D.D. Walgenbach. 1978. First year corn damage: Northern corn root-worm ovipositional studies. Proc NC Br Entomol Soc Am.

Hoogstraal, H., H. Wassef, E.R. Easton, and J.E.W. Dixon. 1977. Observations on the subgenus *Argas* (Ixodoidea: Argasidae: Argas) 12. Argas (A.) *africolumbae:* variation, bird hosts, and distribution in Kenya, Tanzania, South And Southwest Africa (Namibia). Med Entomol 13(4-5):441-445.

Lockwood, M.J., and D.D. Walgenbach. 1978. Western corn rootworm pheromone; Field Studies. Proc NC Br Entomol Soc Am.

McDaniel, B. 1977. Distribution records of mites from rodents from South Dakota.Southwestern Naturalist 23(3):411-416.

Walgenbach, D.D. 1977. Rootworm Research. SD Farm and Home Research 28(3):14-15.

Walgenbach, D.D. 1977. Corn rootworm—insecticide interaction research progress. 17th Ann Prog Rep SE South Dak. Exp Farm.

____, R.S. Hooten, and G.R. Sutter. Root worm resistance monitoring. Proc NC Br Entomol Soc Am.

____, G.K. Kohn, and D.L. Kensler. 1977. U.S. patent #4,012,526: Oxymethylene dicarboxylic acid esters as anti-fungal agents and animal growth promoters. March 15, 1977. Assignors to Chevron Research Company.

____, and G.R. Sutter. 1977. Standard methods for detection of insecticide resistance in Diabrotica sp. larvae and adults. Entomol Soc Am Meetings.

Publications:

Berndt, W.L., and B.H. Kantack. 1977. External parasites of swine. FS 504.

Kantack, B.H. 1978. Corn rootworm control recommendations, South Dakota.

Kantack, B.H., and W.L. Berndt. 1978. Greenbugs on sorghum. SDCES FS 587.

____ and ____. 1977. Grasshopper control. SDCES FS 556.

____ and ____. 1978. Poultry pest control. SDCES FS 451.

____ and ____. 1978. South Dakota insecticide recommendations. SDCES EC 683.

____ and R.W. Kieckhefer. 1978. Economic thresholds and losses in South Dakota spring wheat.

Kantack, B.H. D.D. Walgenbach, and W.L.Berndt. Insect Newsletter, Vol. 18, Published weekly - April to October.

Walgenbach, D.D., B.H. Kantack, and D.L. Reid, Hessian fly in South Dakota; Situation, Prospects, Recommendations. SDCES EMC 778.

Home Economics

Articles:

Deethardt, D.E., M.E. Rust, and W.A. Johnson. 1978. Whole grain wheat, a nutritious snack food. Proc 4th Inter Cong of Food Sci and Technol:372-379.

Dirks, K., and W.A. Johnson. 1978. Nutritional adequacy of pregnant Cheyenne Sioux women. Home Economics Res. J.

Guild, L., and W.A. Johnson. 1978. Differences in distribution pattern of phospholipid fractions in rats fed sucrose- high phosphate diets. Abstr to be published in Proc SD Acad of Sci.

Jensen, J., and W.A. Johnson. 1977. Nutrition and cultural aspects of fifth grade dietaries. Dietetic Assoc Home Economics Res.

Johnson, W.A., and D. Deethardt, 1978. Nutrient content and cooking qualities of selected cuts of buffalo (bison) meat. Presented at the Nat Buffalo Assoc annual meeting.

____ and ____. 1977. Nutrient content of selected cuts of pork. Presented at Nat Livestock and Meat Board.

Horticulture—Forestry

Articles:

Klett, J.E. 1977. Ground cover junipers for the Great Plains. Horticulturist 56(5):26-28.

____. 1977. Effects of nitrogen form on growth of five different Juniperus species. Hort Sci 12(4):409.

____. 1978. Nitrogen nutrition of junipers. Proc Internat Plant Propagator's Society 27: in press.

____. 1978. Miniaturized junipers. SD Farm & Home Res 29(1):9-11.

____. 1978. Shrubs for modern landscaping. SD Farm & Home Res 29(1):14-16.

____. 1978. Effect of additional long days on growth and flowering of single-stem pinched poinsettias. Hort Sci 13(3):30.

____. 1978. Superior ground cover junipers for the Great Plains region. Nurseryman CXLVII (11):9, 52-58.

____. 1978. Evaluation research on promising deciduous shrubs. Nurseryman CXLVIII(3):14-15, 120-123.

____. 1978. Landscaping and retailing principles reviewed at South Dakota conference. American Nurseryman. CXLVII: 8 11, 107-109.

Nordstrom, P.E. 1977. South Dakota snowmobiling. S.D. Conserv Dig 44(6):13-28.

Publications, mass media releases:

Helwig, L.L., and D.M. Martin. 1978. Arbor Day. SDCES FS 437.

____. Select-A-Fact (video and tape, slide set and tape) 1977-Pruning shade trees: 1977-Pruning evergreens; 1978-Tree planting; 1978-Chemical weed control in trees to plant in South Dakota.

____. 1978. Tree Talk vols 1-5.

Klett, J.E., and N.P. Evers. 1978. Welcome to McCrory Gardens. SDAES #9.

Martin, D.M., and P. Prashar. 1978. Selected list of vegetable varieties. SDCES FS 489.

____. 1978. Contributions to "Plains Talk," vols. 11-20, No. 1-6.

____. Preparation of Hort Soc Quarterly Newsletter.

Nordstrom, P.E., T.L. Stephenson, and L. Nies, 1977. Snowmobiling in South Dakota, an analysis. S.D. Dept. of Game, Fish & Parks, Pierre, 283 pp.

____. 1977. South Dakota snowmobiling, S.D. Dept. of Game, Fish and Parks, Pierre, 16 pp.

Prashar, P. 1978. Potatoes. SDAES Circ 219.

Prashar, P., D. DeBoer, A. Dittman and M. Brashier. 1978. Drip vegetables. SD Farm & Home Res 29(2):6-7.

Plant Science

Journal articles:

Arnold, W.E., and D.E. Auch. 1978. Dicamba drift. South Dakota Farm & Home Res 29:12-13.

Auch, D.E. 1977. Dicamba use in relationship to drift injury on soybeans in southeastern South Dakota. MS thesis, SDSU.

Chen, C.H., N.E. Stenberg, and J.G. Ross. 1977. Rapid cloning of big bluestem by tissue culture. Crop Sci 17:847-50.

Dybing, C.D. 1977. Delayed senescence of flax treated with morphactins of antiauxins. Plant Growth Regulator Working Group Proc 4:207-10.

____, and C. Lay. 1978. Growth regulator trials with flax, 1973-1977. Flax Institute of the U.S. Proc 47:in press.

Fiedler, D.J., and J.D. Otta. 1977. Control of Phomopsis blight of eastern redcedar with benomyl. Proc Am Phytopath Soc 4:126.

Fine, L.O., P.D. Weeldreyer, and D.G. Shannon. 1978. Deep plowing. South Dakota Farm & Home Res 29:3-5.

Franks. P.A., C. Lay, and C.D. Dybing 1978. Characterization of flax stomata. Flax Institute of the U.S.Proc 47:in press.

Fryda, S.J., and J.D. Otta. 1977. Epiphytic movement and survival of *Pseudomonas syringae* on spring wheat. Proc Am Phytopath Soc 4:138.

Gardner, W.S. 1977. Sulphur dioxide and ozone air pollution injury to alfalfa in a greenhouse in South Dakota. Proc SD Acad Sci 56:242-43 (abstr).

____, J.D. Otta, and L.S. Wood. 1977. Tomato spotted wilt virus identified in South Dakota. Proc SD Acad Sci 56:242-43 (abstr).

Kenefick, D.G., B.J. Kolp, and E.I. Whitehead. 1977. Relationship of ribonucleic acid degrading enzymes to survival levels of winter barley phenotypes. Crop Sci 17:749-53.

Lo, P.F., C.H. Chen, J.G. Ross, and N.E. Stenberg. 1978. Tissue culture of native warm-season forage grasses. Bot Soc of Am Abstr.

Lunden, A.O. 1977. Bluegrass purity analysis—some precautions for low quality samples. Newsletter of the Assoc of Off Seed Analysts 51:5+.

Malo, D.D. 1977. Relationships between course performance and student backgrounds in an introductory soil science course. J. Agronomic Ed 6:20-4.

McMullen, C.R., W.S. Gardner, and G.A. Myers. 1977. Ultrastructure of corn leaf tissue infected with the ND 18 strain of barley stripe mosaic virus. Proc SD Acad Sci:56:100-4.

____ et al. 1978. Aberrant plastids in barley leaf tissue infected with barley stripe mosaic virus. Phytopath 68:317-25.

Meyer, D.W., J.F. Carter, and F.R. Vigil. 1977. Bromegrass fertilization at six nitrogen rates, long and short term effects. ND Farm Res 34(6):13.

____, and F.R. Vigil. 1977. Bromegrass forage quality unchanged after 20 years of nitrogen fertilizer. Crops and Soils 30(2):24.

Otta, J.D. 1977. Growth effects and migration of *Pseudomonas syringae* in 'Bounty 208' spring wheat seedlings. Proc Am Phytopath Soc 4:139.

____ and L.S. Wood. 1977. Occurrence in South Dakota of a bacterial stalk rot of corn caused by *Erwinia chrysanthemi*. Pl Dis Reptr 61:536-7.

Reeves, D.L. 1978. Registration of Spear oats. Crop Sci 18:524.

Smolik, J.D. 1977. Effects of *Trichoclorus allius* and *Tylenchorhynchus nudus* on growth of sorghum. Pl Dis Reptr 61:855-8.

____. 1978. Influence of previous insecticidal use on ability of carbofuran to control nematode populations in corn and effect on corn yield. Pl Dis Reptr 62(2):95-9.

____. 1978. Effect of nematicide, fungicide, and insecticide treatments on growth of range grasses. SD Acad Sci 57(abstr).

____. 1977. Effect of nematicide treatment on growth of range grasses in field and glasshouse studies. In Proc. of Belowground Ecosystem Symposium, ed J.K. Marshall. Range Sci Series 26:257-60.

Stenberg, N.E., C.H. Chen, and J.G. Ross. 1977. Regeneration of plantlets from leaf cultures of *Lilium longiflorum* Thumb. Proc SD Acad Sci 56:152-8.

Wells, D.G., J.J. Bonnemann, and H.S. Sandhu. 1977. Registration of Gent wheat Crop Sci 17:825-6.

Westin, F.C., and G.D. Lemme. 1978. Landsat spectral signatures: Studies with soil associations and vegetation. Photogrammetric Engineering and Remote Sensing 44(3):315-25.

____. 1978. Organic phosphorus changes over a growing season in some borolls and associated aquoll of South Dakota. Soil Sci Soc of Am J 42(3):472-7.

White, E.M., and E.J. Williamson. 1977. Soil-surface crust and plow-layer differences which may affect runoff quality. SD Acad Sci Proc 56:225-9.

____, ____, and Q. Kingsley. 1977. Correlations between rain and runoff amounts and composition in eastern South Dakota. J Environ Quality 6:251-4.

Progress, field day, and departmental reports:

Arnold, W.E. 1977. What is your weed control program? 27th Ann Soil and Moisture Clinic.

Bonnemann, J.J. 1977. Standard variety small grain trials. PS Pamph 35.

____, and G.W. Erion. 1978. 1977 soybean performance trials. PS Pamph 36.

____, G.L. Holborn and J.R. Johnson. 1978. Alfalfa performance trials, 1972-1977. PS Pamph 40.

Buchenau, G.W., J.D. Smolik, and D.E. Miller. 1977. Effect of tillage practices on diseases of spring wheat at Redfield in 1976. James Valley PR 26-77.

____, ____, and C. Wirth. 1977. Effect of fungicide treatment and tillage practice on root and crown disease of Era spring wheat in 1977. PS pamph 38:31-35.

____ et al. 1978. Effect of tillage practices on disease development and yield of Era spring wheat at Redfield in 1977. James Valley PR 78-19.

Carson, P., E. Adams, R. Gelderman, J. Goos, and R. Nettleton. 1977. Effect of drill applied urea on the growth and yield of small grains grown in eastern South Dakota, 1977. PR 78-6.

____, ____, ____, E. Williamson, and R. Nettleton. 1977. Effect of nitrogen source and application rate with the seed on growth and yield of small grains grown in South Dakota in 1976 and 1977. PR 78-5.

____ et al. 1977. Effects of type and rate of broadcast nitrogen fertilizer on the yields of wheat and barley in South Dakota, 1977. PR 78-4.

Colburn, J.D., D.J. Reid, R. Gelderman, J. Goos, V. Beare, R. Nettleton, and P. Carson, 1977. Small grain variety trials for the northeast district, Grant County, 1977. PR 13.

____. 1977. Certified Seed Directory. SD CIA summer edition.

____. 1977. Plant variety protection poster.

Fine, L.O., and P.D. Weeldreyer. 1978. Reclamation and improvement of glossic Udic natriborolls (alkali claypan soils). PR 78-17.

Gelderman, R.H. 1978. Plant analysis procedures in use at SDSU soil testing laboratory. PS Pamph 42.

____, P. Fixen, J. Goos, and P. Carson. 1977. Effect of potassium fertilizer on corn, 1976-77. PR 10.

Geise, H.A., et al. 1977. Annual progress report, West River crops and soils project. PS Pamph 32.

____ et al. 1977. Annual progress report, West River crops and soils project. PS Pamph 37.

Giles, J.F., and R.A. Sanders. 1978. Tillage efects on spring wheat yield. PR 78-9.

____ and ____. 1978. Alfalfa yields under irrigation, PR 78-12.

____ and ____. 1978. Effect of tillage on yield of furrow irrigated corn. PR 78 15.

Goos, R.J., P.L. Carson, R. Nettleton, R. Gelderman, and E.P. Adams. 1977. Foliar fertilization of corn, Deuel County, 1977. PR 78-9.

____ et al. 1977. Foliar fertilizing soybeans with iron. PR 78-8.

____ et al. 1978. Effect of foliar fertilization on soybean yields, Agronomy Farm, 1977. PR 78-7.

Holburn, G.L. 1977. Inheritance of regrowth and other characters in bromegrass. MS thesis, SDSU.

Keim, D.L., and J.F. Giles. 1978. Spring wheat performance under irrigation. PR 78-10.

Kingsley, Q.S., and J.F. Giles. 1978. Cropping sequences following sunflowers. PR 78-7.

Reid, D.J., J.D. Colburn, R. Gelderman, J. Goos, L. Carson, R. Nettleton, P. Carson, and E.J. Williamson. 1977. Small grain variety fertilizer trials for the central district, Jerauld County, 1977. PR 78-14.

____, J.D. Colburn, R. Gelderman, J. Goos, V. Beare, R. Nettleton, and P. Carson. 1977. Small grain variety fertilizer trials for the northeast district, Grant County, 1977. PR 78-11.

____, J.D. Colburn, R. Gelderman, J. Goos, L. Carson, R. Nettleton, E.J. Williamson, and P. Carson. 1977. Small grain variety trials for the central district, Jerauld County, 1977. PR 78-12.

Ross, J.G. 1977. Alfalfa proprietary variety test yields. Centerville field day report.

____, G.L. Holborn, and J.F. Giles. 1978. Grass-alfalfa variety test PR 78-13.

____ et al. Grass-alfalfa variety test. James Valley Ag Res & Ext Center report.

Vigil, F.R., C.R. Krueger, and D.C. Curtis. 1978. Alternative forage production and utilization systems for the Northern Great Plains. Pasture field day reprt, Norbeck.

____, ____, and G. Emery. 1978. Moisture conservation on interseeded grasslands through the use of annual and perennial crop barriers. Pasture field day report, Norbeck.

Westin, F.C., and D.D. Malo. 1978. Geography of soils, Brookings to Norbeck. 26th Alfalfa Improvement Conf.

Williamson, E.J., J. Goos, R. Nettleton, H. Geise, K. Wonnenberg, and P. Carson, 1977. Effect of phosphorus fertilizer on the yield of three spring wheat varieties, Lyman County, 1977. PR 78-1.

____, P. Carson, R. Gelderman, J. Goos, and B. Nettleton. 1977. Effect of nitrogen carryover on switchgrass forage production. PR 78-2.

____ et al. 1977. Fertilizing big bluestem grass, Brookings County, 1977. PR 78-1.

____ et al. 1977. Fertillizing Pathfinder switchgrass, Brookings County 1977. PR 78-3.

Publications:

Adams, E.P., E.J. Williamson, P. Carson, and R. Gelderman. 1977. Fertilizing barley. SDCES FS 679.

____ et al. 1977. Fertilizing flax. SDCES FS 680.

____ et al. 1977. Fertilizing oats. SDCES FS 678.

____ et al. 1977. Fertilizing wheat. SDCES FS 677.

____ et al. 1977. Fertilizing corn. SDCES FS 432.

____ et al. 1977. Fertilizer facts. SDCES FS 250.

Bonnemann, J.J. 1978. 1977 Corn performance trials. SDAES Circ 221.

____. 1978. 1977 Grain sorghum performance trials. SDAES Circ 222.

Chisholm, T.S., L.D. Kamstra, F.R. Vigil, and G.R. Durland, 1978. Large hay packages: Harvesting through feeding. SDCES FS 689.

Gelderman, R.H., E. Adams, E.J. Williamson, and P.L. Carson. 1977. Explanation of soil test recommendations. PS Pamph 41.

____ et al. 1977. Fertilizer guide for soil test—computerized recommendations PS Pamph 34.

____ et al. 1977. Zinc deficiencies. SDCES FS 674.

Goos, R.J. 1978. Effect of foliar fertilization on soybeans yield and leaf necrosis. MS thesis. SDSU.

Luther, R.M, L.B. Embry, and J.F. Giles. Conventionally dried, solar dried, and acid treated corn and methods of vitamin A supplementation for fattening beef cattle. AS Series 78-26.

Malo, D.D., and P.E. Fixen. 1978. Soils laboratory manual.

Westin, F.C. 1978. Satellite view for the soil scientists. New Directions in Century Three: Strategies for land and water use. Publ 132.

____, and D.D. Malo. 1978. Soils of South Dakota. SDAES Bul 656.

Ross, J.G. 1977. Increasing water utilization efficiency of a pasture grass by increasing aftermath through plant selection. Completion report for A-039-SDAK and A-056-SDAK, Office of Water Research and Technology.

Williamson, E.J., E.P. Adams, P.L. Carson, and R. Gelderman. 1977. Fertilizing pasture and hayland. SDCES FS 425.

Rural Sociology

Publications:

Riley, M.P., and F. Bender. 1978. South Dakota farm facts. SDCES FS 374.

Station Biochemistry

Journal articles:

Greichus, Y.A., A. Greichus, H.A. Draayer, and B. Marshall. 1977. Insecticides, polychlorinated biphenyls and metals in African lake ecosystems. II. Lake McIlwaine, Rhodesia. Bul of Environ Contamination and Toxicology 19(5):444-453.

____, ____, B.D. Ammann and J. Hopcraft. 1977. Insecticides, polychlorinated biphenyls and metals in African lake ecosystems III. Lake Nakuru, Kenya. Bul of Environ Contamination and Toxicology 19(5):454-461.

____, B.D. Gueck and B.D. Ammann. 1977. Organochlorine insecticides, polychlorinated biphenyls and metal residues in some South Dakota birds. Pesticide Monitoring J (in press).

Halverson, A. W., and Gastler, G.F. 1977. Composition of South Dakota feeds. Proc SD Acad Sci 56:212-224.

Huntington, G.B., R.J. Emerick and L.B. Embry. 1977. Sodium bentonite effects when fed at various levels with high concentrate diets to lambs. J Anim Sci 45:119-125.

____ et al. 1977. Sodium bentonite or sodium bicarbonate as aids in feeding high- concentrate diets to lambs. J Anim Sci 46:804-811.

Kumicky, D.D., A.L. Livingston, R.E. Knowles, G.O. Kohler, E. Guenthner, O.E. Olson, and C.W. Carlson. 1977. Xanthophyll availability of alfalfa leaf protein concentrate (Pro-Xan) for broilers and laying hens. Poultry Sci 56:1504-1509.

Olson, O.E. 1978. Selenium in plants as a cause of livestock poisoning. In: Effects

of Poisonous Plants on Livestock, Academic Press, Inc. New York. pp. 121-133.

Field day reports:
Emerick, R.J., B.H. Dunn, and L.B. Embry. 1977. Sodium bentonite and sodium bicarbonate in high-concentrate beef cattle diets. SDAES AS Series 77-13.
____, J.C. Chern, I.S. Palmer, R.A. Nelson, and C.W. Carlson. 1977. Interrelationships of mercury, selenium and arsenic in broiler diets. SDAES AS Series 77-22.
Kang, C.W., R.A. Nelson, C.W. Carlson, and O.E. Olson. 1977. Effect of dietary protein level and restricted feeding on egg production, shell quality and certain biochemical parameters in the laying hen. SDAES AS Series 77-26.

Publications:
Hwang, Wen-Ing. 1977. Bacterial methylation of selenium. MS thesis, SDSU.
Olson, O.E., C.W. Carlson, L.B. Embry, R.J. Emerick, and R.C. Wahlstrom. 1978. Water for livestock. South Dakota Farm & Home Res 29(2):11-15.

Veterinary Science

Journal articles:
Bergeland, M.E. 1977. Necrotic enteritis in nursing piglets. Proc Amer Assoc Veterinary Laboratory Diagnosticians 20:151-158.
____, and H.J. Kurtz. 1977. Edema disease. Pork Industry Handbook, PIH-43.
____, J.P. McAdaragh, and I. Stotz. 1977. Rotaviral enteritis in turkey poults. Proc 26 Western Poultry Disease Conf Davis, CA.
____. 1977. Viral reproductive failure in swine. Proc Am Assoc Swine Pract.
____. 1977. Viral enteritis in swine. Proc Am Assoc Swine Pract.
____. 1978. Miscellaneous causes of nursing pig scours—coccidiosis, C. perfringens Type C, and Salmonellosis. Proc Missouri Pork Producers Annual Meeting.
Draayer, H.A., and C.A. Kirkbride. 1977. An electron microscopic investigation of bovine abortion. Proc 20th Ann Meeting Amer Assoc Vet Lab Diagnosticians, p 47-55.
Ellsworth, S.R. Transmission of Mycobacterium avium among swine: An immunologic and bacteriologic study. MS thesis, SDSU.
Hill, H.T., R.A. Crandall, C.L. Kanitz, J.P. McAdaragh, G.L. Seawright, R.F. Salorzano, and W.C. Stewart. 1977. Recommended minimum standards for diagnostic test employed in the diagnosis of pseudorabies (Aujeszky's Disease). Proc Am Assoc Vet Lab Diagn 20 Ann. 375.
Kirkbride, C.A. 1977. Abortive diseases of cattle: their significance and prevalance. Proc Ann Meeting Soc for Theriogenology, p 135-143.
____. 1977. Results of eight years efforts at diagnosing bovine abortion. Speaker's Syllabi. 89th Ca Vet Med Assoc Meeting, p 178-180.
____. 1977. Field and laboratory diagnosis of bovine abortion. Speaker's syllabi. 89th Ca Vet Med Assoc Meeting, p 183-187.
____. 1978. Abortion diseases in swine. Proc 19th Ann George A. Young SPF Conference, p. 23-27.
____, and J.P. McAdaragh. 1978. Infectious agents associated with fetal and early neonatal death and abortion in swine. JAVMA 172:480-482.
Leslie, P.F., M.A. Anson, and J.P. McAdaragh. 1977. Virologic diagnosis of pseudorabies in terminal host species. Proc 20th Annual Meeting Amer Assoc Vet Lab Diagnosticians: 11-16.
Stotz. I.J., and Y.A. Greichus. 1978. Effects of polychlorinated biphenyl (Aroclor 1254) on the white pelican: Ultrastructure of Hepatocytes. Bul of Environ Contamination & Toxicology: 319-325.
Wohlgemuth, K., P.F. Leslie, D.E. Reed, and D.K. Smidt. 1978. Pseudorabies virus associated with abortion in swine. JAVMA 172:478-479.

Wildlife & Fisheries Sciences

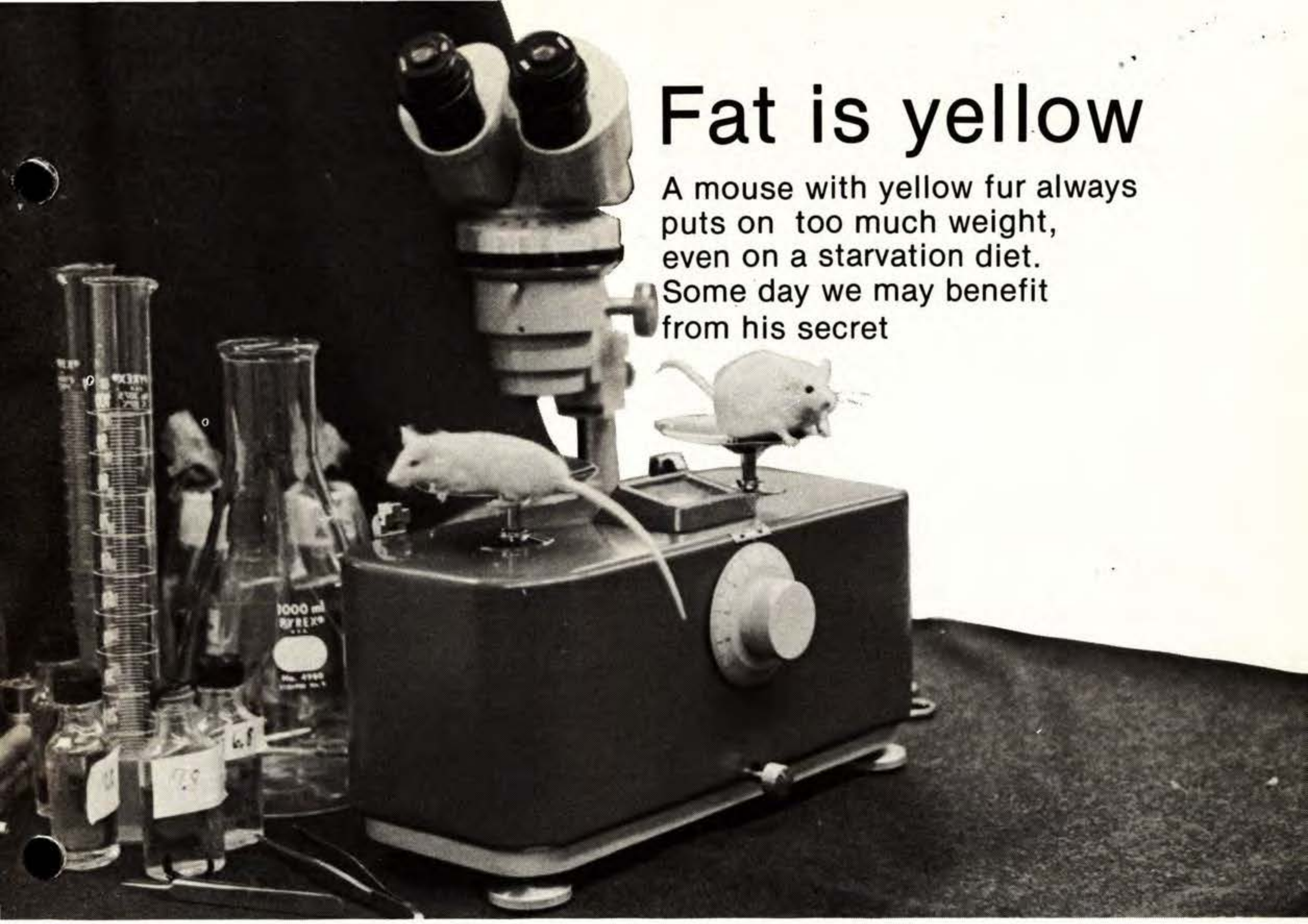
Journal Articles:
Applegate, R.L., and R.W. Kieckhefer. 1977. Ecology of Corixidae (water boatman) in Lake Poinsett, South Dakota. Am Midl Nat 97:198-208.
Applegate, R.L., and W.L. Kruckenberg. 1978. First-year growth and food of largemouth bass in a South Dakota barrow pit stocked with fathead minnows. Prog Fish Cult 40(1):7-9.
Bich, J.P., and C.G. Scalet. 1977. Fishes of the Little Missouri River, South Dakota. Proc SD Acad Sci 56:163-177.
Brewster, W.G., and L.D. Flake. 1977. South Dakota waterfowl; an important contribution to continental duck production. SD Conserv Digest 44(3):5-7.
Emmerich, J.M. 1977. The other season. SD Conserv Digest 44(2):12-14.
Flake, L.D., G.L. Petersen, and W.L. Tucker. 1977. Habitat relationship of breeding waterfowl on stock ponds in northwestern South Dakota. Proc SD Acad Sci 56:135-151.
____, and R.A. Olson. 1977. A nesting study of the ring-necked pheasant. SD Conserv Digest 44(3):7-10.
Fredrickson, L.F., R.L. Linder, R.B. Dahlgren, and C.G. Trautman. 1978. Pheasant reproduction and survival as related to agricultural fertilizer use. J Wildl Mgmt 42(1):40-45.
Payer. R.D., and C.G. Scalet. 1978. Population and production estimates of fathead minnows in South Dakota Prairie wetland. Prog Fish Cult 40(2):63-66.
Scalet, C.G. 1977. Summer food habits of sympatric stream populations of spotted bass, *Micropterus punctulatus*, and largemouth bass, *M. salmoides*. Southwest Nat 21(4):493-501.
Summers, C.A., and R.L. Linder. 1978. Food habits of the black-tailed prairie dog in western South Dakota. J Range Mgmt 31(2):134-136.
Tacha, T.C., R.L. Linder, and T. L. Kuck. 1978. Analysis of aerial circling surveys for Canada goose breeding populations. Wildl Soc Bull 6(1):42-44.
VandenBerge, R.J., and P.A. Vohs. 1977. Population status of beavers on the free-running Missouri River in southeastern South Dakota. Proc SD Acad Sci 56:230-236.

Publications
Flake, L.D. 1978. Pheasant nesting ecology. SDCES FS 691.

Budget

South Dakota Agricultural Experiment Station
Fiscal Year 1978

Source of Funds:	6-30-77	6-30-78
State appropriations (general funds)	2,993,200	3,151,655
Continuing federal appropriations (Hatch & RRF)	1,300,451	1,457,227
Continuing federal appropriations (M/S)	55,886	55,000
Federal grants & contracts (USDA)	149,347	140,015
Federal grants & contracts (not USDA)	271,354	198,299
State agencies grants	109,078	145,383
Private grants & contracts	218,608	194,377
Internal, statewide & industry services	360,294	468,728
Replacement livestock & feed purchases	662,495	596,935
Total	5,581,196	6,407,619
Sales income to general fund	9,581	573,519
Net support from general fund	$2,804,519	$3,145,920



Fat is yellow

A mouse with yellow fur always puts on too much weight, even on a starvation diet. Some day we may benefit from his secret

Mouse, microscope, and man—they add up to a curious combination when they include yellow mice that always get too fat, an electron microscope that magnifies up to one million times larger, and a researcher named Nels H. Granholm.

Granholm, Agricultural Experiment Station scientist and director of the SDSU electron microscope facility, works with a strain of the common house mouse. Most people might note color as the only difference between the ordinary pests in the corncrib and Granholm's mice. Instead of the usual blackish color, his are born yellow.

The scientist explains that when these mice show a yellow coat color, they also have a 100% chance of one day being fat—very fat.

Besides these two obvious characteristics, geneticists know that a yellow mouse has a certain hereditary background. They know that a living yellow mouse is carrying one gene, or trait, for the yellow characteristic. They also know a developing yellow mouse embryo that happens to be tagged with two yellow genes will die in very early embryonic stages, never to be born.

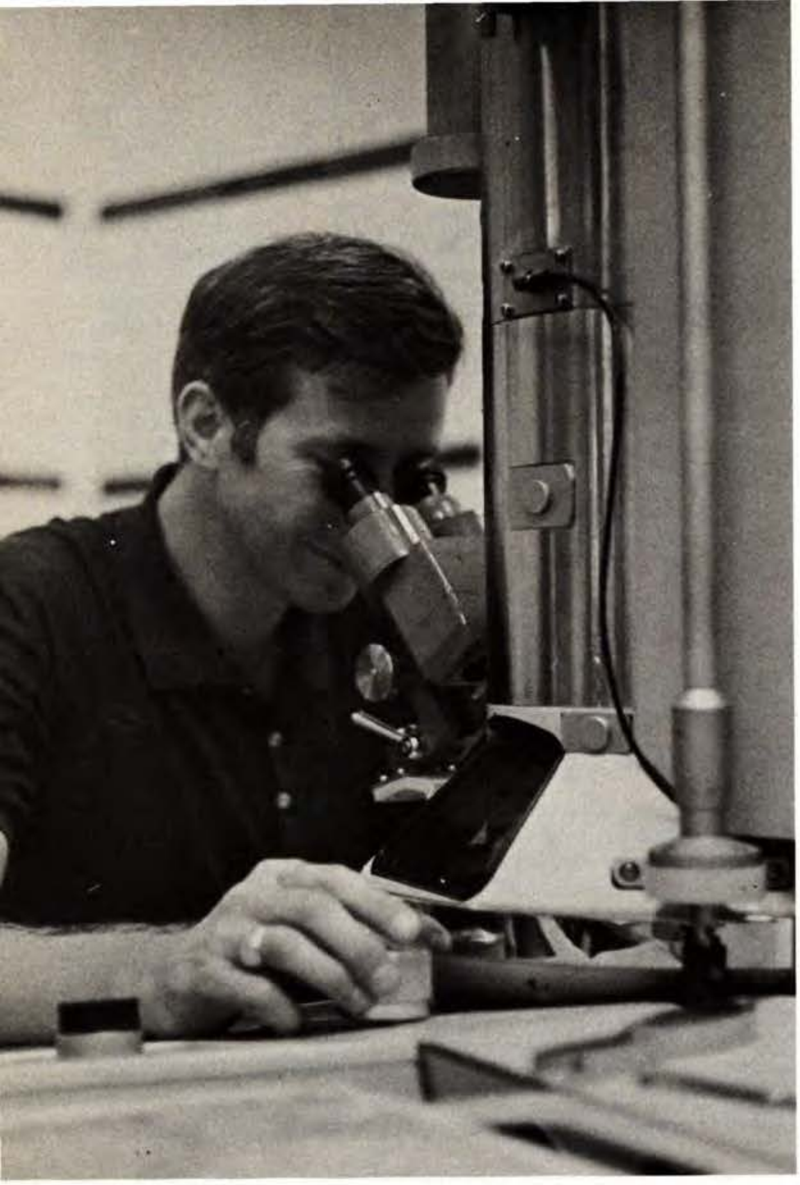
But to non-scientists, what's so special about a yellow mouse? They may be significant if you have an extremely stubborn weight problem. Or, if you have pigs that you'd like to have bigger litters. Or, if you're interested in getting a 200% lamb crop. Or if you have cattle you'd like to gain more on less feed.

Basic research lays foundation for all scientific knowledge

Granholm's current research does not pretend to answer those problems, but his research could have important impacts on solving them. This scientist's work is called basic research. That is, he and co-workers are zeroing in on extremely fundamental parts of these problems.

For example, he has recently studied the very specific changes of the yellow mouse embryo in its very early development, during the first 3 days of growth. During this time, scientists say the embryo passes through the 2-cell, on to the 8-cell, and into the blastocyst stages.

Monitoring this development requires intricate lab techniques to extract the developing embryos and the use of an electron microscope



The electron microscope gives Nels Granholm a picture of what happens in a 3-day-old mouse embryo.

to witness the development. But also intriguing is the amount of nutritional knowledge that already has been uncovered to allow the scientist to keep the developing embryo alive outside the uterus and in artificial culture.

Strangely enough, the 2-cell stage through the 8-cell stage of an embryo takes about the same amount of time in swine, cattle, sheep, horses, mice, and humans. The 2-cell stage occurs on the first day for all of those animals and just slightly longer, 1.5 days, for humans. The embryo develops to the 8-cell stage in 2 days for swine; 2.5 days for sheep, mice, and humans; and 3 days for cattle and horses.

In the early days of an embryo, Granholm says a number of things are necessary and essential. Timing is especially critical when the embryo becomes implanted in the uterus. But not all of these early critical factors are known, and pinpointing some of these with the yellow mouse is exactly what Granholm's research is all about.

In a recent scientific journal, Granholm described the results of monitoring embryos from 77 yellow female mice. Basically he reported a developmental lag in cell structure which may be caused by the early effects of the yellow expression. He found that the gene for yellowness is working as early as the first 48-60 hours of a developing embryo. Previously, this had been suspected to occur much later. Through photographs and observations, Granholm reported not just when, but what, was happening at these early stages.

"We know that gene action and expression works very much the same for most animals," Granholm explains. "So by understanding better how genes work in mice, we hope to learn more about genetic action in other animals."

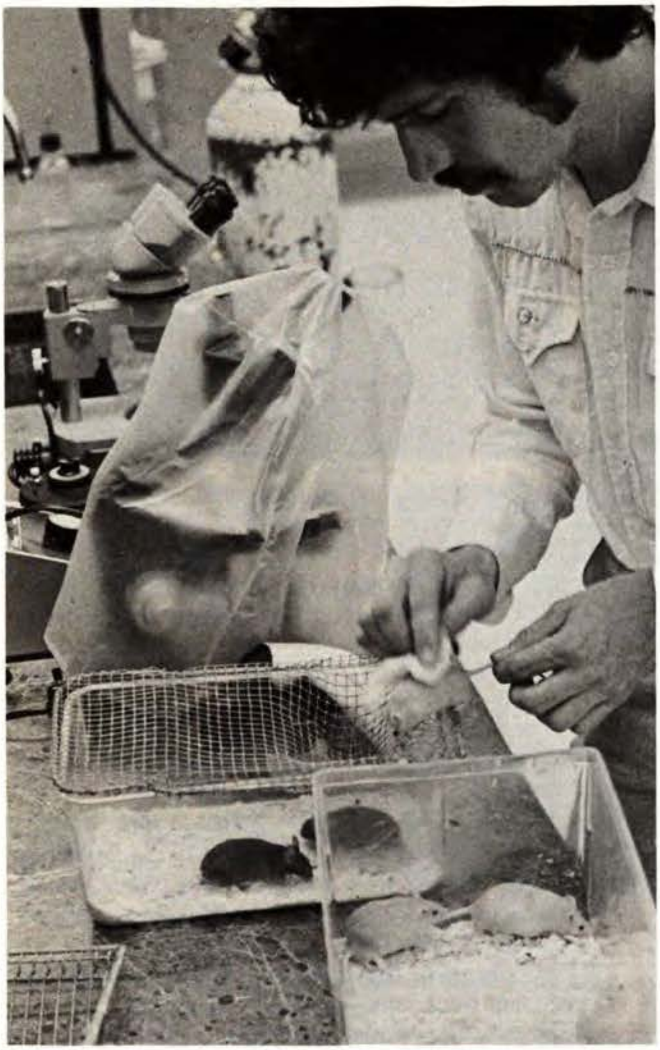
What secrets are locked in those fat little bodies?

The yellow mice that actually survive birth are interesting characters in many ways. According to Granholm, they always get fat. For his laboratory studies, a yellow mouse will produce only about two litters before it becomes too fat to be capable of producing more. The young are born about the same size as ordinary mice. But as they get older, they get fatter. Most live about two-thirds as long as their black counterparts.

The yellow mice can be fed the same diet as the black mice, and every time the yellow mice gain excess weight while the black ones stay slim and trim. In fact, a yellow mouse cannot be fed in any known way to be kept from developing the extra fatty deposits.

Why is this? That is just another question Granholm and other scientists would like to answer. Perhaps you feed livestock for fattening. Could this little yellow mouse help un-

The little guy behind mother is destined to become fat, even if put on a starvation diet. His black litter mate will stay slim. Mother will die soon.



Kevin Brock, who assists Granholm, swabs down a yellow mouse. The black mice are a different strain, born tailless, and used in another experiment.

cover more about efficient feed conversion? What does this yellow mouse have that makes him gain more weight with less food?

Or, perhaps you've been working on a diet yourself and the pounds just don't come off. Probably most people don't try hard enough. But what about those with extraordinary difficulty? Does this particular mouse offer possible aid for them? For now, no one knows.

For some reason, again unknown, about 90% of some strains of yellow mice eventually get certain kinds of cancer. Perhaps these special mice will help some one disclose more of the mysteries of this disease.

These mice relate to another basic question that especially interests Granholm. Why does a sow, for example, normally shed about 17.0 living ova, or eggs, with only an average of 7.3 pigs actually surviving through birth?

This problem is not unique to sows, but occurs naturally with other livestock, mice, and humans, too. Many more eggs are produced than survive. Eventually, Granholm would like to explore pig embryos closely in much the same way he monitors the yellow mice.

But mice will remain his prime subjects during the coming year. As this publication went to press, Granholm was leaving SDSU temporarily for approximately a year to study at the Jackson Laboratory at Bar Harbor, Maine. This laboratory, where the SDSU yellow mice originated, is the largest center of mammalian genetics research in the world.

Granholm, who also spent a stint several years ago in the Antarctic studying penguin embryology, is enthusiastic about working with some of the special colonies of mice available at the Jackson lab. These animals are especially valuable because they are genetically controlled. They may have recorded genetic history dating back hundreds of generations. They may be inbred, or bred within families. They may be hybrids, or one breed bred to another breed. Or, they may be mutant mice with a collection of hereditary oddities.

At the Bar Harbor institution, Granholm will work beside approximately 38 other scientists and 400 other associated researchers who deal with heredity-related studies about such enigmas as cancer, muscular dystrophy, diabetes, radiation exposure, and aging.

But when Granholm returns to SDSU next summer, more yellow mice will be waiting for him with more questions to be explored. □

New role for crop wastes?

Cash from your crop residue? Glucose production on farms could raise income and hedge against fuel shortages. It's the first step in making alcohol

A scientist at SDSU is working on a process which may help farmers produce another kind of cash crop: stored solar energy. That energy is glucose, a sugar which is the essence of stored solar energy and the substance from which alcohol is made.

The scientist is microbiologist Paul Middaugh. He explains that farmers could market part of the glucose found in the cellulose of crop and animal residue which may total as much as 25 pounds per person worldwide each day. A similar glucose, found in edible starch of farm crops, is far easier to extract, but starch is part of our basic food supply while cellulose isn't.

Glucose, a valuable product in both human foods and animal rations, has a variety of medicinal and other industrial applications, one of which is making alcohol used in the fuel "gasohol."

Glucose production may be a farm operation of the future

"Glucose is a step behind alcohol in the manufacturing process, but it's an exciting prospect for on-farm production," Middaugh said. "If a simple process can be developed for making glucose from farm residue, farmers will have a new way to intensify their profitability, and they've also hedged against that day when gasohol may become needed as a fuel. Once you have a supply of glucose, making alcohol is relatively simple."

Whether or not agricultural alcohol is in such demand, Middaugh doesn't forsee having a "still" in every farmyard. "The manufacture of so volatile and explosive a substance is not something you conduct next door to your family home," he said. "Further, the U.S. Treasury Department Alcohol Tax Unit has some very stringent requirements which would be difficult to meet on the farm."

A more likely system is one in which the first steps of the process would be completed on the farm, while a nearby plant would then ferment, distill, or otherwise process the glucose.

Farmers would gather farm residue, pretreat it for processing, and add the enzyme to produce glucose. Bulk trucks would pick up the glucose much the same as milk is picked up from today's dairy farms.

Farmers would be paid either in cash or in finished product which may include yeast protein for animal feed, fertilizer, cooking sugar, antibiotics, molasses substitute for silage, alcohols, or even plastics of various kinds.

SDSU research has two major objectives

"We have two major objectives in this project," says Middaugh. "First, we want to determine the minimum equipment needed for on-farm manufacture of glucose, and second, we want to compare production costs with returns."

Several grants allow the work at SDSU to continue. The National Rural Electric Cooperative Association in Washington, D.C., provided \$10,000 in "seed" money for purchase of initial equipment and materials. The East River Electric Cooperative at Madison pledged as much as \$30,000 if needed, and a U.S. Department of Energy grant is being sought for pre-treatment equipment for an on-farm demonstration and for a column distillery for further processing experiments at SDSU.

"Taking glucose sugar from the cellulose of farm residue is no ordinary challenge," says the scientist. "Every step of the process has inherent problems which must be solved before on-farm production of glucose is practical."

A basic problem is one which precedes the process itself.

"There's a definite danger in over-promoting these possibilities before the technology is fully developed," he said. "If farmers purchase equipment before the economics justify it, they'll be discouraged and so will their neighbors," says Middaugh.

Some scientists are concerned about energy requirements of distillation, damage to soil condition which may result from residue removal, and various other aspects of the process.

One of Middaugh's immediate concerns is the processing of cellulose.

Separating cellulose is like picking straws from jello

Cellulose containing glucose sugar is sandwiched within other substances including hemicellulose and lignin, and separating one from

If and when on-farm glucose production becomes economically feasible, bulk tank trucks could haul it to market.

Microbiologist Paul Middaugh monitors operation of a $200 surplus dairy tank he has adapted for glucose research.

the others is difficult. Middaugh describes photomicrographs of cellulose as looking like straws stuck in red jello.

A powerful enzyme must be applied to the "straws" of cellulose to free up the sugar they contain, but first the "jello" must be removed to clear a pathway for the enzyme to reach the cellulose.

This normally is accomplished by milling the material. The finer the particles, the more cellulose surface exposed to the enzyme and the greater the yield of sugar.

Search is for more active enzyme at lower cost

The next hurdle is the enzyme itself.

In converting starch to sugar, two enzymes are used. These are produced in commercial quantity and cost only about $1 per pound. Enzyme for the cellulose process, by contrast, costs from $10 to $20 per pound.

"I was appalled to find that commercial pilot samples of this enzyme are not only high priced but also very low in activity," says Middaugh.

"We're now in sort of a waiting period," he said. "Until someone buys a large quantity of the enzyme, the price won't come down. And until the price comes down, nobody will buy a large quantity."

Here's where Middaugh's industrial experience comes into play. He has undertaken development of a process for manufacturing a more active enzyme at much lower cost.

The necessary enzyme is produced by a mutation of *Trichoderma viridae*, a South Pacific organism called "jungle rot" by U.S. servicemen stationed there during World War II. The name reflects the organism's ability to destroy cotton materials—from shirts to webbed belts—in a matter of weeks.

U.S. Quartermaster Corps, responsible for equipping the troops, worked on keeping Trichoderma from eating all the cotton-based material in the Pacific theater. In solving the problem, they also discoverd that ultraviolet light caused the organism to mutate into a form twice as active as the original.

Scientists since have mutated it into a form 10 to 15 times more active, although it has not yet been released to researchers.

Middaugh explains that the more active the organism, the greater amount of enzyme it will produce at a given cost. Commercial costs for the presently available enzyme are $1400 for enough to digest a ton of biomass.

"I'm following the effort to further mutate Trichoderma with great interest," he says. Research is being conducted at Rutgers University, the U.S. Quartermaster Lab at Natick, Mass., and elsewhere.

"We must remember that the penicillium mold is now about 150,000 times more active than when it was first discovered," he added. "This has been accomplished through laboratory mutation, and it's conceivable that a similar result can be obtained with our little 'cotton eater,' Trichoderma."

Middaugh already has found that by using a growth medium of powdered spruce wood, and by incubating the present Trichoderma, he can produce the enzyme for about a tenth of the cost. A more active form than the commercial enzyme also results.

It takes about 40 pounds of spruce powder to produce enough enzyme for a ton of crop residue, and Middaugh is satisfied with its cost as a growth medium.

"Enzyme is one of the major cost inputs for making glucose or alcohol from refuse," he explained. "That's why I've concentrated my effort on this. If I can't whip this, there's no reason for grinding up the corn stalks or other residue in the first place."

To produce the enzyme, Middaugh uses a surplus dairy tank he purchased for $200. He is awaiting an automatic pH control unit to regulate acidity. He now does this "by hand"—using anhydrous ammonia, which also feeds the organism and makes it grow. Middaugh explains that acidity builds during the process to the point where it will kill the Trichoderma mold.

"Once I get the process fully automated, I expect to lower the cost of the enzyme required for a ton of refuse to about $100," he said. "But the high yields of enzyme I need will have to wait until the equipment arrives—and until the new Trichoderma mutant is released."

"I now believe I can demonstrate this process repeatedly and with good results," he said.

Meanwhile . . .

It's still an "iffy" project in some respects, but a guardedly excited microbiologist at SDSU is pursuing its completion and enjoying every minute of the "chase." □

Sun power

Farmers report their fuel-cost savings after using no-frills home-built solar grain drying units from SDSU design

The use of solar energy in agriculture is considerably past the drawing board stage at SDSU, thanks to the cooperation of several area farmers who have built and used solar grain drying units designed by the school's agricultural engineering department.

Farmers, who have always been the chief harvesters of the sun's powers by converting it to food and fiber, are now able to save significant quantities of scarce electricity and propane through the system, according to Bill Peterson, Extension agricultural engineer—and one of the prime designers of the system.

According to Peterson, almost 400 sets of the plan for the home-built solar unit have been ordered by farmers since it was briefly publicized last July. Orders for the $1 plan also have come from other states and several foreign countries.

The units can be built with materials which have averaged about $800 in cost in the several constructed so far.

Peterson explains that the amount of solar energy striking a properly tilted, south-facing surface on a clear fall day in South Dakota totals about 1600 British Thermal Units (BTU's) per day per square foot.

That potential, when channeled through moving air into shelled corn in a 5,000-bushel bin, can save a farmer about $100 a year in fuel costs even at a relatively low equivalent rate of two cents per kilowatt hour of electricity saved. The "clincher" is that electrical rates aren't expected to remain at this low rate for long—and, in fact, are already higher than this in many areas. Peterson says that an annual increase of even 8% would double the cost of electrical energy in just 10 years. And the higher the cost of such energy, the greater the pay-back from a solar collector for grain drying.

A workable unit is simplicity itself

The SDSU design is simplicity itself, as Peterson describes it. Although several collector materials and physical specifications are still being tested, the solar unit basically consists of wrapping a round grain bin in a corrugated, black material, then blowing heated air from the space between the material and the bin wall into the grain.

"We've been monitoring the results of five solar-heat drying bins built within this general concept," added Peterson.

Moisture content removal among the five units has ranged from 3-12%, and operating costs have ranged from 2-9 cents per bushel. The cost for removing 1% of moisture from one bushel of shelled corn has varied from a low of one-fourth cent to a high of three-fourths cent.

Lowest costs, obviously, were among drying bins which used no supplemental heat, but depended entirely on solar power for drying the grain. Cost per bushel for these units was only about half of the cost for the others.

Deluxe variations perform no better than stripped down model

Several variations of the basic plan have been tested, according to Mylo Hellickson, professor of agricultural engineering at SDSU, but findings are that a bare-sheet collector, without a transparent fiberglass cover, and made from ordinary corrugated roofing material painted black, serves as a simple, low-cost, and long-lived solar unit for the low temperature rise required for drying.

"However, " says Peterson, "because the sun-warmed surface is exposed to cold air and wind, this unit is most suitable for installations in which air velocity from the blower is relatively high. Air picks up heat better when it is moving fast. We've found that the simpler unit works fine when the air velocity behind the black sheet is 1000 cubic feet per minute or more."

Other versions included the addition of a layer of clear plastic over the black collector material and spaced the same distance from it as the collector is from the bin wall. Later, this was replaced with a clear fiberglass sheeting. Temperature rise was about the same for either version.

Cooperators report substantial savings

A solar unit installed on the Myron Pederson farm near Arlington gives an additional 10 degrees of heat at noon on a sunny day—about the same as a 19.2 kilowatt electric heater could give.

Compared with a conventional drying bin on a neighboring farm, the Pederson unit operated for about 26% less cost while producing about identical results.

Retested a year later, when the amount of sunlight was more favorable, savings amounted to 55%.

Engineers also tested an installation at the James Valley Research and Extension Center, operated by SDSU near Redfield. This solar unit provided a unique test in that it featured five types of collectors, all on the same drying bin.

Two of the collectors are a covered variety, similar to Pederson's. One used clear polyethylene, and the other used corrugated clear fiberglass. The bottom three all were bare-sheet collectors and included hand-corrugated aluminum sheets, corrugated steel roofing and corrugated aluminum roofing.

All performed well, but results indicated that the bare-sheet collectors gave nearly the same efficiency, but at less cost and probably longer life.

A commercially manufactured unit of the same general design was tested at the Southeast Experiment Farm near Beresford, but the bin was considerably larger than the others.

This collector was built from corrugated galvanized steel coated with black plastic and mounted 5 inches from the bin wall. The collector produced the same amount of heat at noon on a clear day as a 20-kilowatt electrical heater. During the test, from November 17-22, 1976, corn was dried at a cost of about one-fourth cent per bushel for each percent of moisture removed.

Compared with a nearby conventional bin using fuel-heated air and a stirring device, the solar unit operated for about half the cost.

Jay Nebben, who farms near Dell Rapids, used his solar drying bin for the first time last fall and took 7½% of the moisture from 1900 bushels for a cost of two cents per bushel—or about a fourth cent per bushel for each percent of moisture removed. His collector cost about $700 to build.

Roger Hoffman, located near Clear Lake, dried 3400 bushels in his solar bin which cost $1200 to build, and which uses propane for supplemental heat. He spent $64.40 for electricity to operate the blower and $239 for propane to dry corn which averaged 27% at the beginning. This totalled about three-fourths cent per bushel for each percent of moisture removed. However, cost for drying in his non-solar batch dryer was about 40% higher than this.

All the installations were adapted from the basic SDSU plan for solar drying bins, and all operated as low-temperature bin-drying systems which, in themselves, will dry corn for about half as much energy as the rapid-dry systems.

"Crop drying is one of the most energy-intensive operations on the farm," says Peterson, "but low-temperature drying, an efficient process which requires a minimum temperature rise of only 5 to 10 degrees, offers a worthwhile alternative to high-temp drying—and one which adapts readily to solar power."

Solar energy for drying is a proven option

The energy situation in the United States is indicated daily to Americans through prices on neighborhood service station gasoline pumps, utility bills, and, to a large extent, grocery costs. Just 5 years ago, this nation imported 36% of its oil supply at a cost of under $5 per barrel. Last year, imports equalled 47% of the domestic supply, and the price had risen to about $15 per barrel.

"America needs energy options, but no Americans need them more than those who raise our food," says Robert Deimel, assistant editor of *Agricultural Research*. "The dawn of the post-petroleum era has found American agriculture wide awake. And that is not surprising. The ingenuity behind the new technology has been a part of American agriculture for a long, long time." □

West River Center

Headquarters is mostly just a place to keep books and pick up the mail. Main work is on cooperators' ranches

Serving South Dakota on a statewide basis but with emphasis on livestock production and crops best adapted to western South Dakota is the West River Research and Extension Center.

Located at the southern edge of the Central States Fairgrounds at 801 San Francisco in Rapid City the office now houses six Agricultural Experiment Station research staff members and eight Cooperative Extension Service personnel who are members of the staff of the College of Agriculture and Biological Sciences (ABS) at SDSU. In terms of staffing this is the largest of three research and Extension centers operated by SDSU.

The Center was established in 1969 by consolidating area Extension positions in 4-H and beef production located in Rapid City with research positions in range management and livestock that were housed at the research substation in Newell.

A blue ribbon from the Cheyenne River Achievement Days has many hours of work behind it, not only for the youngsters, but for the 4-H staff at the Center.

Starting with six positions, the Center now has four plant scientists, three animal science positions, three in range management, one specialist in community development, one in 4-H, and two administrators plus secretarial support staff. All but one of the added positions have been transfers from Brookings. All research and Extension programs are administered through departments located within the College of Agriculture at SDSU. Cattlemen, homemakers, farmers, youth and industry alike benefit from the vast resource of information and expertise now available through the West River Center.

Specialists and research staff members located at the Center travel as much as 200 miles to work with farm and ranch cooperators. The two Extension supervisors plus specialists and scientists located in the Center work closely with county agents and home economists throughout the 19-county area as well as their counterparts located on the SDSU campus.

West River's program in crops and soils is unusual

The crops and soils research portion of the program is unique in that research plots for crop production are not maintained at one central location. All experimental plots are cooperative with farmers, ranchers, and county agents and researchers to test crops, soils, plant pathology, and weed control.

Research is conducted at one site for no more than 3 years on a consecutive basis. This means that the crop research program is flexible and can accommodate a wide variety of soils and crops found in western South Dakota.

Research agronomist Harry Geise (pronounced guys) and assistant Jim Bishop conduct experimentation in crop production, breeding disease control, and land management, which includes irrigation systems.

Always of interest to farmers are the crop variety trials which include old and new varieties of crops grown in the western half of the state.

Geise feels the results of crop variety trials help farmers and ranchers decide which seed varieties to choose. Farmers can benefit substantially by switching to varieties that have proven themselves in the demonstration plots throughout the area.

For example, by planting 100 acres of winter wheat that yields 3.5 bushels per acre more than seed planted last year a farmer grossed an additional \$770, based on wheat price of \$2.20 a bushel. Developing crops and using pesticides and fertilizers which produce higher income per acre with minimum harm to environment is what the plant science research is all about.

Presenting such information to area farmers and ranchers through educational programs is Claire Stymiest, who joined the staff as an Extension agronomist this year. Extension specialists such as Stymiest act as a source of information for county agents and producers,

Jim Bishop, assistant research agronomist, is sending data back to Brookings through the remote computer terminal located in the Rapid City office. At right, Jim Johnson, Extension range specialist, suggests the best pasture management for top beef production.

supporting and complementing the local county Extension efforts.

Beef and range are major activities

Most beef cattle research originating from the Center is done at the Cottonwood Range Field Station and the Fort Meade research unit. Other beef research is carried on at Antelope Range Station.

Increasing the productivity of livestock herds through improved nutrition, herd management, and breeding systems is the major goal of research conducted by Gene Deutscher, beef cattle researcher. (He has now moved to North Platte, Neb.)

It is estimated that South Dakota ranchers lose 24,000 calves each year through calving difficulty with heifers. Using proper management techniques developed through research, losses could be cut in half, resulting in a $1.5 million savings for the state's beef producers.

In the important field of range science, range researcher Bob Gartner, assistant Rich Butterfield and Extension range specialist Jim Johnson are informing ranchers of the need for sound range management.

Seventy-one percent of the land west of the Missouri River is classified as rangeland, making it one of South Dakota's most important natural resources. Private landowners in Pennington, Lawrence, Meade, Ziebach, and Custer counties lend land as experiment sites for a variety of research on range improvement practices.

Mechanical practices include chiseling, ripping, contour furrowing and interseeding. "Research to date as well as practical knowledge from landowners indicates at least a two fold increase in forage production when recommended range improvement practices are followed," Gartner said.

Clare Borich, center, coordinates Extension work in the district. Here she is with Bonnie Egge, 4-H, and Janet Seaman, home economics, both of Rapid City.

By increasing moisture retention ability of the soil, faster and more nutritious plant growth results which increases pasture carrying capacity. "Increased forage production can increase livestock production, but because of the many factors involved, it's hard to say exactly how much," he said.

Another research project on which Gartner is working involves prescribed burning of range and forest land to control weeds and small shrubs. Burning trials so far seem to result in significant reductions of Japanese brome, Kentucky bluegrass and certain types of woody plants. At the same time burning cover leaves stands of western wheatgrass virtually unchanged.

Gartner serves as coordinator for the Old West Regional Commission's five-state range program. The program, headquartered at the Center, is administered by the Society for Range Management through a grant from the Commission.

The 4-year project will end in 1979, hopefully providing the impetus for lasting range management educational programs. Among program accomplishments so far: compiling range inventory data, documentary films concerning range management and ecology, sponsoring youth camps on range management, and public education programs on range management.

Extension livestock specialists Mick Crandall and Charles McPeake are responsible for developing and carrying out a broad range of educational programs in breeding, nutrition, and management of beef cattle and sheep. The staff, under McPeake's direction, is conducting a mail survey on beef cattle management practices and production efficiency. Ranchers who complete the survey forms will receive a computer printout comparing their herd with those of other cattlemen. The comparison should help cattlemen identify potential areas for improvement in their operation, McPeake said.

The South Dakota Beef Cattle Improvement Association which was founded by Henry Holzman, Extension livestock specialist, emeritus, and now with McPeake serving as executive secretary is also housed at the Center. It is an organization of commercial and purebred beef breeders interested in performance testing for the improvement of beef cattle.

Tourism development is part of educational program

Arnold Bateman, rural development specialist, has a split appointment between Extension and research. His Extension responsibilities include work with public and private recreation facilities, public services, and leadership development within community groups.

Bateman's research efforts in natural resource development are designed to improve the economic well-being of both rural and urban residents of western South Dakota. Recently, he has concentrated on providing economic based information to the public and private sectors for planning recreational facilities and services.

He offers suggestions to the private recreation industry on setting prices, marketing their product, site selection, attracting clientele, and record keeping. "The research will help private owners provide the types of recreational facilities and services which are needed to attract people to South Dakota and increase the length of their stay and the amount of money they spend in the state," Bateman said. "It helps them to provide the type of management training they need to make their businesses successful."

Studying the possibilities of public school systems and governments sharing the cost and use of recreational facilities is an upcoming project of the rural development work. "It's looking at a more efficient way of using tax dollars being spent on recreation, yet providing better quality recreational facilities for the public," he said.

The Center serves agriculture through several other programs which are allied with other projects.

The beef direct marketing project was established by a grant from the Federal Extension Service and administered by SDSU and the University of Wyoming. The project, under Director Dave Hewlett, will test different alternatives for direct marketing of beef from producer to consumers.

Another Extension staff position is the state 4-H youth specialist, Ken Nelson. Nelson is involved with developing and coordinating 4-H programs in western South Dakota. He also provides leadership training to the county 4-H programs.

Two district Extension supervisor positions, one held by Clare Borich and the other recently vacated, provide administration, supervision, and coordination for the Center and for county Extension programs in the west district. The supervisors work closely with the county agents and home economists to coordinate programs which serve the individual county's needs. □

Publications off the press

The Agricultural Experiment Station and the Cooperative Extension Service distribute a large variety of publications to South Dakota citizens. Your county Extension office will have copies for you. Publications on the following topics were printed in August and September 1978.

FS 587 Greenbug Control on Sorghum (rev)
FS 700 Irrigation Energy Alternatives
FS 701 Energy Efficient Crop Drying
FS 702 Manure Use in Cropping
FS 703 Conserving Energy with Reduced Tillage Systems
FS 704 Efficient Irrigation Pumps
FS 705 Energy Use in Livestock Buildings
FS 706 Efficient Machinery Operation
FS 707 Investment of Education and School Land Funds
FS 708 Mineral Rights on School Lands
FS 709 Number of Legislative Days
FS 710 Two Thirds Vote
FS 711 Lifeline Rate Reform
FS 712 Repeal of Milk Marketing Act
FS 713 Regulation of Obscenity
EMC 736 Summary of Basic Changes in Federal Estate Law
EC 722 Alfalfa—An Economic Alternative to Corn
B 656 Soils of South Dakota
B 661 Population Update #1—The Elderly
B 662 Factors that Determine Where a Farmer Buys and Sells
TB 46 Seasonal and Regional Differences in Cows' Milk

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